RADER-WOLF-COUGAR
WATERSHED ANALYSIS

First Iteration

20 September 1996

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RADER-WOLF-COUGAR
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I. INTRODUCTION

The Rader-Wolf and the Cougar Watershed Analysis Units (23,548 and 7527 acres, respectively) were combined for this analysis. Collectively, they will be referred to as the Rader-Wolf-Cougar Watershed Analysis Unit (hereafter referred to as RWC).

RWC is located in the western portion of the Tyee Resource Area, approximately 20 miles northwest of Roseburg (Figure I-1). Approximately 91 percent of the WAU is situated in the Roseburg District of the BLM; approximately 2500 acres occur on the Coos Bay District.

The Rader-Wolf watershed consists of 9 watershed compartments ranging in size from about 1.6 to 8.6 mi^2 (Figure I-2). Wolf Creek is the main tributary, it is a sixth order stream that flow into the Umpqua River which is a 9th order stream. The watershed ranges in elevation from about 280 ft at the confluence of the Umpqua River to 2,488 ft at the peak of Old Blue.

The Cougar watershed has 3 compartments ranging in size from 2.5 to 5.4 mi^2 (Figure 2). Cougar Creek is the main tributary, it is a fifth order stream that flow into the Umpqua River about 3 mi upstream of the confluence of Wolf Creek. The Cougar Creek watershed ranges in elevation from 280 ft at the confluence of the Umpqua River to about 2,480 ft at an unnamed peak on Bateman Ridge or to about 2,480 ft at an unnamed peak on Rattlesnake Ridge.

There are 3 major plant groups represented in RWC. They are the D-RA-SM (Douglas-fir, red alder, salmonberry); D-RA-VM (Douglas-fir, red alder, vine maple); and MC-IV-GR (mixed conifer, interior valley, grass) groups. Douglas-fir is the principal plant series in each group. The D-RA-VM groups occupies the majority of the area (90 percent). The predominate overstory species in the D-RA-VM plant group is Douglas-fir. Western hemlock may dominate in localized areas. Red alder is found in drainages and on wetter sites. Vine maple, hazel, willow, and other deciduous brush species make up a large component of the understory. Moisture is ordinarily not a limiting factor to conifer establishment, but sprouting brush and red alder may limit light necessary for conifer growth. Descriptions of the MC-IV-GR and D-RA-SM plant groups are contained in the Roseburg District's and the Coos Bay District Proposed Resource Management Plan/Environmental Impact Statement (USDI 1994a, USDI 1994b). Progression through the seral stages is similar for all three plant groups; the early seral stage is dominated by herbs and shrubs, hardwoods enter the the groups in the mid seral stages, and ultimately all stands are dominated by conifers (Table I-1).

Table I-1. Dominant plant group vegetation[1], by seral stage.					
Plant Group	Seral Stages				
	Early	Mid	Late	Mature	Old Growth
MC-IV-GR	G-He-Sh	C-Sh-Hd	C-Hd	C	C
D-RA-SM	He-Sh-Hd	C-Hd	C-Hd	C	C
D-RA-VM	He-Sh-Hd	C-Hd	C-Hd	C	C

[1] G = Grass; He = Herb; Sh = Shrub; Hd = Hardwood; C = Conifer

The BLM manages over 17,000 acres of forest land in RWC; privately owned lands account for over 13,800 acres (Table I-2).

Table I-2. Land ownership within the Rader-Wolf-Cougar Watershed Analysis Unit.		
	Area (ac.)	Percent (%)
CBWR[1]	74	0.43 [2]
PD[1]	544	3.15 [2]
OC[1]	16,627	96.42 [2]
Federal	17,245	55.49
Private	13,831	44.51

[1] CBWR = Coos Bay Wagon Road lands; PD = Public Domain lands; OC = Oregon and California Railroad lands.
[2] Percent of Federal lands.

Under the Northwest Forest Plan (USDA and USDI 1994) RWC, with the exception of 132 acres of GFMA, is designated as LSR (Figure I-3). These lands are a portion of the larger Mapped LSR (RO 263) that extends to the northwest into the Coos Bay District of the BLM.

Watershed analysis was begun 02 February 1996 with formation of the ID Team. The ID Team is composed of:

Chris Foster...	Team Lead	Lowell Duell...	Hydrology
Joe Witt...	Wildlife	Al James...	Silviculture

Don Rivard...	Fisheries	Keving Cleary...	Fuels
Evan Olson...	Botany	Dan Cressy...	Soil
Scott Center...	USFWS		

In accordance with RIEC directives, dated 28 August 1995, this watershed analysis will be completed following the guidance of the Federal guide (USDA, et al. 1995) for watershed analysis. The ID Team decided that there were no additional concerns in RWC that would not be adequately addressed under the Core Topics identified in the Federal guide. Those core topics are: erosion processes, hydrology, fisheries (stream channel), water quality, vegetation, species and habitats, and human uses.

This document will be arranged by core topic, sections II-VIII. Each core topic section will follow the outline identified in the Federal guide -- Steps:

1. Characterization of the watershed
2. Identification of issues and key questions
3. Description of current condition
4. Description of reference condition
5. Synthesis and interpretation of information
6. Recommendations

Section IX will contain integrated recommendations for future treatments/management directions to undertake within the analysis area.

II. SOILS (Erosion Processes)

Characterization:

The RWC topography was shaped by the mass wasting and surface erosion on a geologic time scale. Catastrophic processes no doubt played a major role in shaping the landscape. The historic record in the aerial photos captures a small glimpse of catastrophic processes particularly during the "one hundred year event" of the 64 floods and to a lesser extent in the mid fifties to late fifties and early eighties when large debris avalanche-debris torrent combinations and large slump-earth flows occurred. The erosional process continues today both in undisturbed forest and lands under management. Cumulatively roads have been the most impacting although in-unit slides have had their share of significant impacts. Significant numbers of large landslides have occurred in undisturbed forests during the exceptional precipitation events.

Understanding the geology gives insights to the erosional and soil formation processes. Three geologic formations are present in the map compiled mapped by Alan and Wendy Niems of Oregon State University. They are shown on Figure II-1 and are described below.

Tee ELKTON FORMATION (middle Eocene: Ulatisian)--Micaceous siltstone with thin to thick sandstone lenses and rhythmically interbedded thin graded micaceous sandstone and siltstone. Unit is approximately 3,000 feet thick. It may interfinger with the upper part of the Tyee Formation. Some thicker bedded to cross-bedded better sorted sandstone occurs near the top of the formation (Baldwin, 1974).

Tet BAUGHMAN LOOKOUT MEMBER of the TYEE FORMATION middle Eocene;ulatisian)-- Very thick-bedded to massive micaceous lithic-arkosic sandstone; medium to very coarse-grained; rarely cross-bedded; minor interbedded siltstone; cliff former; 2500 ft. thick; interpreted as deltaic facies (Molenaar, 1985.

Teb BATEMAN FORMATION (middle Eocene; lower Narizian)-- Thick-bedded to cross-bedded, medium-grained micaceous arkosic sandstone and minor siltstone; locally bearing subbituminous coal and carbonaceous siltstone; Many sandstone beds are massive to cross-bedded. Some are laminated to ripple cross-laminated and bioturbated. Deltaic and shallow marine unit, approx. 1500 feet thick (Baldwin, 1974; Weatherby, in progress).

In the case of the Tyee formation, the dip of the strata (Figure II-2a.) and the common presence of massive cemented sandstone appears to greatly influence topographic features. Generally very steep (65 to 100+ percent) and highly incised dissected mountain slopes developed on aspects opposite of the direction of the dip (Figure II-2b.). On the opposite side of the ridge where the slopes are more in line with the dip, the slopes generally are considerably less steep (20 to 65 percent typical) and less dissected. An example of this is Sec. 19, T25S, R7W along Rattlesnake Ridge (Figure II-2c.).

This relationship with dip does not appear to hold up as well with the Bateman Formation (Figure II-2d.). Part of the reason could be that much of the Bateman formation does not have nearly as much well cemented sandstone. Mountain slopes tend to be very steep and highly dissected on both sides of the ridge divide. An example is the SW1/4 Sec. 21, T25S, R8W at Bateman Ridge (Figure II-2d).

The Elkton formation is characterized by deep layering of siltstone and very fine sandstones up to 3000 feet deep. They are soft and brittle and weather rapidly when exposed. A relatively thin layering of strata similar to Tyee may cap this deep layering of siltstones and very fine sandstones. A characteristic topographic profile in the WAU has a narrow steep ridgeline of remnant sandstone cap with broad, gently sloping benches on both sides. The benches may have stream gorges cut into them. An example of this is the E1/2 of Sec. 29, T24S, R8W. in the Whiskey Creek division (Figure II-2e.).

For all three formations the following generalizations about soil formation may be made:

> On the steeper slopes where the bedding is sandstone soils tend to have shallower depths, have lower clay contents and have more gravel. They also tend to be over harder bedrock. These slopes are prone to shallow translational slides of the debris avalanche type.
>
> On the steeper slopes where there are thick beds of siltstone and very fine sandstones, more deep-seated earth flow slides occur. The soils are typically of moderate depths and more clayey.
>
> On slopes of the Tyee Formation in pretty good alignment with the dip and on the more gentle slopes formed over the siltstones and very fine sandstones of the Elkton Formation, soils tend to have moderate to deep depths and textures higher in clay and are subject to deep-seated slump-earth flows.

Figures II-3 through II-6 and associated table (Table II-1) delineate important soil properties. These maps were derived from the Natural Resource Conservation Service soil survey of Douglas County. The map giving each soil mapping unit delineation and the accompanying soil property tables are in Appendix 3.

Table II-1. Extent of selected soil properties in the Rader-Wolf-Cougar WAU.					
Soil Property		Extent (ac.)	Percent of area	Figure #	Key to Map
SLOPE	0-30 percent	9,138	29.4	II-3	Green
	30-60 percent	12,200	39.3		Yellow
	60-90 percent	9,738	31.3		Red
SOIL DEPTH	Shallow and Rocky	1,809	5.8	II-4	Dotted Red
	Shallow, not Rocky	3,822	12.3		Red
	Moderately Average Depths	15,737	50.6		Yellow
	Deep Average Depths	9,706	31.2		Green
SUBSOIL TEXTURE	Loamy	11,530	37.1	II-5	Light Blue
	Loamy-Skelatal	10,411	33.5		Dark Blue
	Clayey	9,135	29.4		Red
SOIL MOISTURE REGIMES AND DRAINAGE	Xeric (well and moderately well drained)	19,439	62.6	II-6	Yellow
	Udic (well and moderately well drained)	11,320	36.3		Green
	Somewhat Poorly Drained	286	00.9		Blue
	Aquic/Poorly Drained	28	00.1		Red

Issues and Key Questions:

Soil productivity and water quality are the issues of most importance from the soil resource perspective. Management of the land in the watershed (primarily road construction and maintenance and timber harvesting) has had a significant impact through accelerated surface erosion and mass wasting as well as extensive compaction and the alteration of the hydrology. These processes have had significant impacts, in particular during the larger and more infrequent storm events.

The key questions are:

What impacts are currently being created and what are their short term and long term implications?

What are the long term impacts to the soils of past management and natural processes?

Landslide Inventory:

An inventory was done of landslides and segments of riparian zones and stream channels which were drastically disturbed as a result of debris torrents and flooding. The main tool was the interpretation of aerial photos from 1959 to July 1994. Field inspections revealed others which occurred since the last photo flight. The span of time covered would be about 1954 to present. The total number of actual slides during this span of time is probably considerably undercounted due to various limitations on aerial photo interpretation especially where forest canopies hide the smaller slides. Refer to the appendix for a full accounting of the limitations (Appendix 3).

The slides were categorized as small (less than 0.1 acre), medium (0.1 to 0.5 acre) and large (greater than 0.5 acre). Most small slides had relatively minor impact on water quality unless they directly entered a drainage channel which flows. They also have had minor impact on soil productivity when considering the entire area of the WAU. Large slides appeared to have almost always impacted streams in a direct and substantial manner. Soil productivity in the zones of depletion of these large slides were often severely impacted, especially if scouring went deep into subsoils or bedrock. To better visualize the size classes, a borderline small-medium slide might be about 35 ft. wide and 125 ft. long while a borderline medium-large slide might be 70 ft. wide and 310 ft. long.

The slides were also categorized as to their place of origin and cause. Those categorized under the label of "forest" originated in undisturbed natural stands or reestablished forests of at least ten years of age. In-unit related slides originated in young clearcuts or thinnings and were not apparently caused by roads. Road related slides were caused by the undercutting of support by a road cut, by the concentration of road drainage, by the sidecast loading of slopes or by a combination of the three. Judgement calls had to often be made on slides which occurred a short distance below a road (Was road drainage a factor?). Many old growth stands had a network of trails created many years ago which are hard to detect on aerial photos. They were probably used in selective harvesting. Some of these trails could have been factors in slides classified as "forest".

Tables II-3 through II-13 summarize the data in different ways. Some of the figures most useful in the analysis are listed below:

- 552 slides over a span of 42 years were identified (Table II-3).

- About 18 percent of these slides originated in forest (Table II-6). This figure is considerably higher than past watershed analysis. Part of the reason is probably attributable to large acreages of established forest remaining on unstable soils and geologic strata during the '64 flood and other big precipitation events.

♦ Sixty percent of the forest slides occurred during the wet season of the '64 floods (1964-65)[59 of 98 slides (Table II-4).

♦ In-unit slides were most common (48 percent) but the greatest number of large slides were road related (54 percent) followed by forest slides (32 percent) and then in-unit slides (14 percent). In-unit slides accounted for the largest grouping in the medium range (Table II-7). The high percentage of large forest slides is attributable to exceptional storm events. In particularly the 64 flood event, where large areas of sensitive landslide-prone slopes were still in undisturbed forest.

Road Inventory:

A road inventory was done by studying the aerial photos from 1959 to 1994 and from field notes. Those roads and major bladed skid trails which were not in the GIS data base and were judged substantial enough were added to the road map in this report (Figures II-7 through II-10). These included old unsurfaced roads grown over with vegetation and not accessible to traffic and new roads which have not made it into the GIS system yet. Table II-2 gives the GIS and the revised road density figures. The revised road density of 4.8 miles/square mile is 36 percent higher than the GIS figure for the entire WAU.

Table II-2. Road densities in the Rader-Wolf-Cougar WAU.

Compartment	Area (mi^2)	Identified in GIS		GIS and roads added through photointerpretation and recon.	
		road miles	density (mi/mi^2)	road miles	density (mi/mi^2)
Caseknife	2.1	5.0	2.4	9.4	4.5
Little Wolf	5.5	18.7	3.4	23.9	4.3
Lower L. Wolf	2.7	5.7	2.1	10.5	3.9
Lower Wolf	3.2	11.1	3.5	21.3	6.7
Middle Wolf	5.0	18.7	3.7	23.2	4.6
Miner Creek	1.6	8.2	5.1	14.1	8.8
Rader Creek	8.6	33.6	3.9	43.5	5.1
Upper Wolf	3.8	17.8	4.7	26.7	7.0
Whiskey Creek	4.3	16.9	3.9	20.4	4.7
Cougar Creek	5.4	20.4	3.8	23.2	4.3
Extra Cougar	2.5	11.0	4.4	11.9	4.8
Upper Cougar	3.9	12.3	3.2	17.9	4.6
RWC WAU	51.6	180.4	3.7	246.0	4.8

Table II-3. Landslide distribution within the Rader-Wolf-Cougar WAU (as observed from aerial photography).								
Time Period	Small (<0.1 ac)		Medium (0.1-0.5 ac)		Large (> 0.5 ac)		Total	
	#	per year	#	per year	#	per year	#	per year
1954 - 1959	20	4.0	22	4.4	13	2.6	55	11.0
1959 - 7/1964	12	2.4	13	2.6	3	0.6	28	5.6
7/1964 - 7/1965	20	20	48	48	26	26	94	94
7/1965 - 8/1970	12	2.4	21	4.2	21	4.2	54	10.8
8/1970 - 5/1978	50	6.3	45	5.6	18	2.3	113	14.1
5/1978 - 5/1983	66	13.2	57	11.4	24	4.8	147	29.4
5/1983 - 6/1989	26	4.3	16	2.7	7	1.2	49	8.2
6/1989 - 7/1994	4	0.8	8	1.6	0	0	12	2.4
1959 - 1995	210	5.3	230	5.8	112	2.8	552	13.8

Figure II-a.

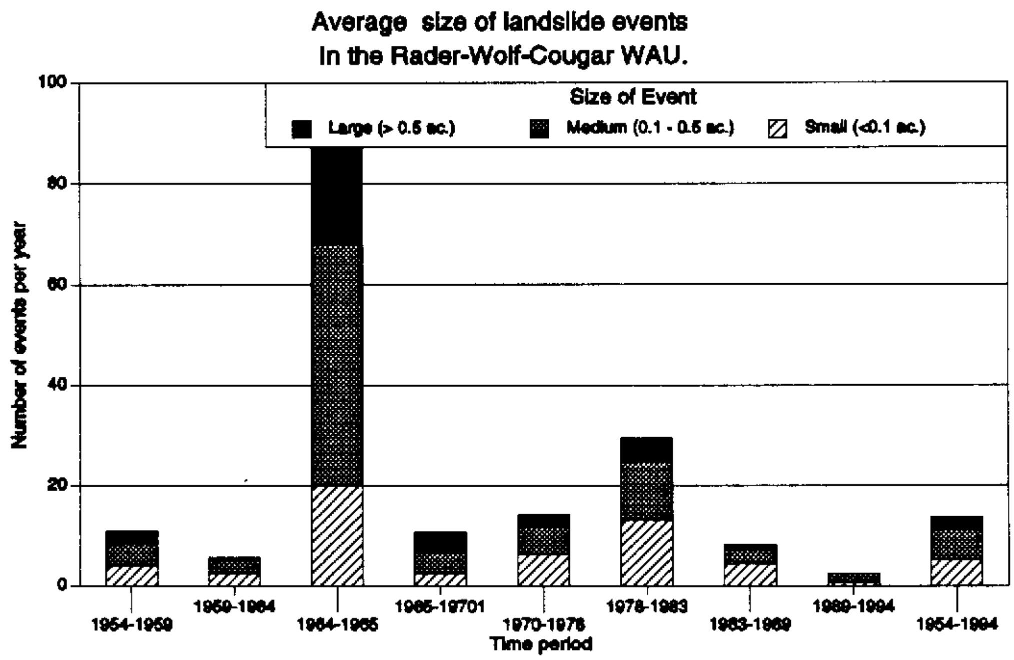


Table II-4. Landslide origin within the Rader-Wolf-Cougar WAU (as observed from aerial photography).								
Time Period	Forest (not mgmt. related)		In-Unit Related		Road Related		Total	
	#	per year	#	per year	#	per year	#	per year
1954 - 1959	8	1.6	16	3.2	31	6.2	55	11.0
1959 - 7/1964	7	1.4	15	3.0	6	1.2	28	5.6
7/1964 - 7/1965	59	59	26	26	9	9	94	94
7/1965 - 8/1970	4	0.8	21	4.2	29	5.8	54	10.8
8/1970 - 5/1978	2	0.25	62	7.8	49	6.1	113	14.1
5/1978 - 5/1983	10	2.0	92	18.4	45	9.0	147	29.4
5/1983 - 6/1989	7	1.2	27	4.5	15	2.5	49	8.2
6/1989 - 7/1994	1	0.2	6	1.2	5	1.0	12	2.4
1959 - 1995	98	2.5	265	6.6	189	4.7	552	13.8

Figure II-b.

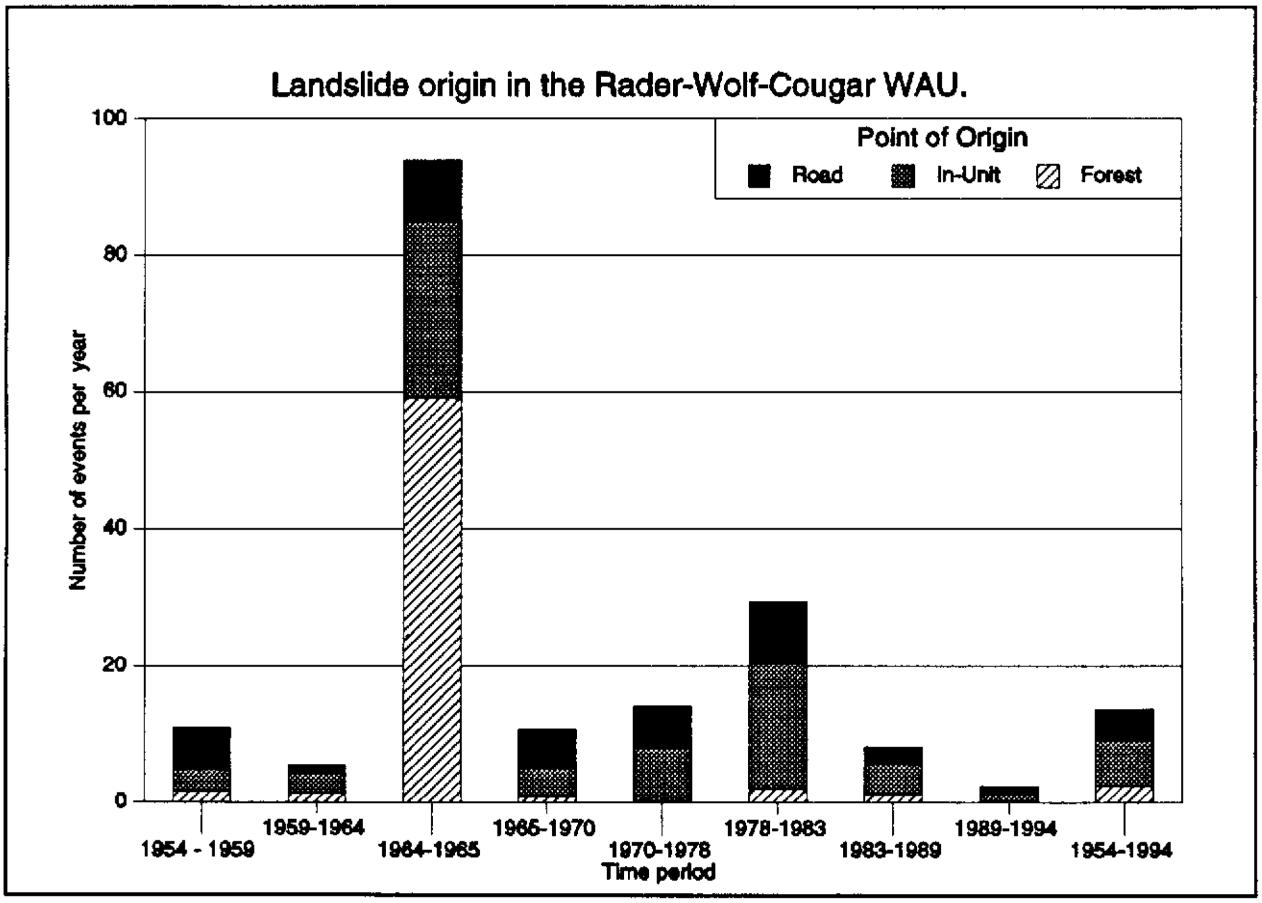


Table II-5. Landslide distribution, by compartment, within the Rader-Wolf-Cougar WAU (as observed from aerial photography).

Compartment	Small (<0.1 ac.)	Medium (0.1-0.5 ac)	Large (>0.5 ac)	Total	
				#	percent
Cougar Cr	37	43	8	88	15.9
Upper Cougar	45	46	23	114	20.7
Extra Cougar	5	8	7	20	3.6
Lower L. Wolf	5	14	4	23	4.2
Little Wolf	19	22	15	56	10.1
Caseknife	12	25	5	42	7.6
Miner Cr	10	8	4	22	4.0
Whiskey Cr	14	13	7	34	6.2
Middle Wolf	11	10	4	25	4.6
Rader Cr	22	31	34	87	15.8
Lower Wolf	7	2	0	9	1.6
Upper Wolf	23	8	1	32	5.8
RWC WAU	210 (38 %)	230 (42 %)	112 (20 %)	552	100

Table II-6. Landslide origin, by compartment, within the Rader-Wolf-Cougar WAU (as observed from aerial photography).

Compartment	Forest (unrelated to mgmt)	In-Unit Related	Road Related	Total	
				#	percent
Cougar Cr	17	47	24	88	15.9
Upper Cougar	29	60	25	114	20.7
Extra Cougar	8	7	5	20	3.6
Lower L. Wolf	14	5	4	23	4.2
Little Wolf	14	22	20	56	10.1
Caseknife	2	27	13	42	7.6
Miner Cr	1	11	10	22	4.0
Whiskey Cr	7	14	13	34	6.2
Middle Wolf	2	14	9	25	4.5
Rader Cr	4	33	50	87	15.8
Lower Wolf	0	7	2	9	1.6
Upper Wolf	0	18	14	32	5.8
RWC WAU	98 (17.8%)	265 (48.0 %)	189 (34.2 %)	552	100

Table II-7. Landslide distribution, size by origin, within the Rader-Wolf-Cougar WAU (as observed from aerial photography).								
Size[1]	Forest (unrelated to mgmt)		In-Unit Related		Road Related		**BASE** Total	
	#	percent	#	percent	#	percent	#	percent
Small	21	10.0	148	70.1	42	19.9	211	100
Medium	42	18.3	101	43.9	89	37.8	230	100
Large	35	31.5	16	14.4	60	54.1	111	100
Total	98	17.8	265	48.0	189	34.2	552	100
Small	21	21.4	148	55.8	42	22.2	211	38.2
Medium	42	42.9	101	38.1	87	46.0	230	41.7
Large	35	35.7	16	6.0	60	31.7	111	20.1
BASE Total	98	100	265	100	189	100	552	100

[1] Small = <0.1 ac.; Medium = 0.1- 0.5 ac.; Large = >0.5 ac.

Table II-8. Landslide distribution (July 1964-July 1965), by compartment, within the Rader-Wolf-Cougar WAU (as observed from aerial photography).

Compartment	Small (<0.1 ac.)	Medium (0.1-0.5 ac)	Large (>0.5 ac)	Total	
				#	percent
Cougar Cr	5	6	3	14	14.9
Upper Cougar	5	12	8	25	26.6
Extra Cougar	0	3	4	7	7.4
Lower L. Wolf	1	7	2	10	10.6
Little Wolf	4	9	7	20	21.3
Caseknife	3	11	2	16	17.0
Miner Cr*	1	0	0	1	10.6
Whiskey Cr*	0	0	0	0	0.0
Middle Wolf	‡	‡	‡	‡	‡
Rader Cr	‡	‡	‡	‡	‡
Lower Wolf*	1	0	0	1	1.1
Upper Wolf	‡	‡	‡	‡	‡
RWC WAU*	20 (21.3%)	48 (51.1 %)	26 (27.7 %)	94	100

* small area covered by 1965 photos
‡ no coverage by 1965 photos

Table II-9. Landslide origin (July 1964-July 1965), by compartment, within the Rader-Wolf-Cougar WAU (as observed from aerial photography).

Compartment	Forest (unrelated to mgmt.)	In-Unit Related	Road Related	Total	
				#	percent
Cougar Cr	14	0	0	14	14.9
Upper Cougar	21	1	3	25	26.6
Extra Cougar	7	0	0	7	7.4
Lower L. Wolf	7	1	2	10	10.6
Little Wolf	8	10	2	20	21.3
Caseknife	2	12	2	16	7.5
Miner Cr*	0	1	0	1	1.1
Whiskey Cr*	0	0	0	0	0.0
Middle Wolf	‡	‡	‡	‡	‡
Rader Cr	‡	‡	‡	‡	‡
Lower Wolf*	0	1	0	1	1.1
Upper Wolf	‡	‡	‡	‡	‡
RWC WAU*	59 (62.8 %)	26 (27.7 %)	9 (9.6 %)	94	100

* small area covered by 1965 photos
‡ no coverage by 1965 photos

Table II-10. Landslide distribution (July 1964 to July 1965), by size and origin, in the Rader-Wolf-Cougar WAU (as observed from aerial photography).								
Size[1]	Forest (unrelated to mgmt)		In-Unit Related		Road Related		**BASE** Total	
	#	percent	#	percent	#	percent	#	percent
Small	12	60.0	7	35.0	1	5.0	20	100
Medium	28	58.3	14	29.2	6	12.5	48	100
Large	19	73.1	5	19.2	2	8.0	26	100
Total	59	62.8	26	27.7	9	9.6	94	100
Small	12	20.3	7	26.9	1	11.1	20	21.3
Medium	28	47.5	14	53.8	6	67.7	48	51.1
Large	19	32.2	5	19.2	2	22.2	26	27.7
BASE Total	59	100	26	100	9	100	94	100
1 Small = <0.1 ac.; Medium = 0.1- 0.5 ac.; Large = >0.5 ac.ome of these trails								

Table II-11. Landslide distribution (excluding the July 1964-July 1965 time period), by compartment, within the Rader-Wolf-Cougar WAU (as observed from aerial photography).					
Compartment	Small (<0.1 ac.)	Medium (0.1-0.5 ac)	Large (>0.5 ac)	Total	
				#	percent
Cougar Cr	32	37	5	74	16.2
Upper Cougar	40	34	15	89	19.4
Extra Cougar	5	5	3	13	2.8
Lower L. Wolf	4	7	2	13	2.8
Little Wolf	15	13	8	36	7.9
Caseknife	9	14	3	26	5.7
Miner Cr	9	8	4	21	4.6
Whiskey Cr	14	13	7	34	7.4
Middle Wolf	11	10	4	25	5.5
Rader Cr	22	31	34	87	19.0
Lower Wolf	6	2	0	8	1.7
Upper Wolf	23	8	1	32	7.0
RWC WAU	190 (41.5 %)	182 (39.7 %)	86 (18.8 %)	458	100

Table II-12. Landslide origin (excluding the July 1964-July 1965 time period), by compartment, within the Rader-Wolf-Cougar WAU (as observed from aerial photography).					
Compartment	Forest (unrelated to mgmt.)	In-Unit Related	Road Related	Total	
				#	percent
Cougar Cr	3	47	24	74	16.2
Upper Cougar	8	59	22	89	19.4
Extra Cougar	1	7	5	13	2.8
Lower L. Wolf	7	4	2	13	2.8
Little Wolf	6	12	18	36	7.9
Caseknife	0	15	9	26	5.7
Miner Cr	1	10	10	21	4.6
Whiskey Cr	7	15	13	34	7.4
Middle Wolf	2	14	9	25	5.5
Rader Cr	4	33	50	87	19.0
Lower Wolf	0	6	2	8	1.7
Upper Wolf	0	18	14	32	7.0
RWC WAU	39 (8.5 %)	240 (52.4 %)	178 (38.9 %)	458	100

Table II-13. Landslide distribution (excluding the July 1964 to July 1965 time period), by size and origin, in the Rader-Wolf-Cougar WAU (as observed from aerial photography).								
Size[1]	Forest (unrelated to mgmt)		In-Unit Related		Road Related		**BASE** Total	
	#	percent	#	percent	#	percent	#	percent
Small	9	4.7	141	73.8	41	21.5	191	100
Medium	14	7.7	87	47.8	81	44.5	182	100
Large	16	18.8	11	12.9	58	68.2	85	100
Total	39	8.5	239	52.2	180	39.3	458	100
Small	9	23.1	141	59.0	41	22.8	191	41.7
Medium	14	35.9	87	36.4	81	45.0	182	39.7
Large	16	41.0	11	46.0	58	32.2	85	18.6
BASE Total	39	100	239	100	180	100	458	100
1 Small = <0.1 ac.; Medium = 0.1- 0.5 ac.; Large = >0.5 ac.								

Historical Analysis:

In 1959 nearly all of the BLM lands were still untouched. In the western one third of the Rader-Wolf WAU and in the Cougar Creek watershed only a small percentage of the private land had been clearcut and only two mainstem roads had been built (24-8-35.1 and 25-8-1.0). The most widespread activity in this area appears to have been selective harvesting in old growth stands leaving a network of small trails.

In other areas of the WAU (the eastern two-thirds of the Rader Creek and Wolf Creek watersheds) extensive clearcutting has occurred on private land, by the mid-sixties. The method of harvesting overwhelmingly used in the 1950s and early 1960s was ground based. It involved a dense and extensive network of unsurfaced haul roads and skid trails (many bladed, especially on the steeper terrain). Trails occurred on slopes as steep as 70 percent. The pattern of skid trails was commonly very dense on the gentle terrain (less than 40 percent slope). Due to the influence of the Elkton formation on the development of the landscape, a large percentage of the land was gentle enough for this type of harvesting to be extensively employed.

Surface erosion must have been a very significant short term impact on water quality especially where the activity occurred in riparian zones and on the steeper slopes. Long term soil productivity losses due to compaction, erosion and mechanical displacement of the topsoil must also have been significant. Ground based activity occurred into the 1980s, but most of the harvesting was done by cable yarding as the more difficult terrains were accessed.

Figures II-a and II-b give the average number of inventoried landslides per year for each time interval between aerial photo flights (Tables II-3 and II-4). Since the first flight was 1959, the time interval it effectively revealed slides is presumed to be five years. One graph separates the slides according to size and the other according to origin (forest, road related, and in-unit related).

A fair amount of slide activity occurred in the mid- to late fifties. Three exceptionally large slides in old growth apparently occurred in the same year and may have been associated with an exceptional precipitation event. Two were on the very steep slopes of Bateman Ridge in Upper Cougar. The other was on a steep canyon slope adjacent to a tributary of Miner Creek in the NE1/4SW1/4NE1/4 of Section 27, T24S,R8W. The largest one (in Upper Cougar) covered about five acres.

The period of 1959 to 7/64 had relatively little landslide activity. Only three large slides were noted (Table II-3).

The following one year period took in the December 64 flood event (Tables II-8 through II-10). Only in the southern part of the WAU was there 1965 photo coverage. Here 94 slides were noted (17 percent of all the slides for the entire 42 year period). The most impressive were debris avalanche-torrent combinations which originated on the very steep forested slopes of Bateman Ridge in Upper Cougar and Lower Little Wolf. Seven debris avalanches fed into one torrent in Upper Cougar. It and another torrent joined at the confluence of two tributaries at the base of Bateman Ridge where hundreds of logs and earth debris were deposited. The longest path of these joined torrents was about 9200 feet horizontal distance. A 4800 ft. long debris avalanche-torrent in Lower Little Wolf completely removed all trees and other vegetation in a 120 ft. wide by 2400 ft. long swath.

Bateman Ridge above where these debris avalanches-torrents originated is 2000 to 2550 ft. in elevation. Rain-on-snow might have been a contributing factor on these very steep slopes. The generally weakly cemented nature of the Bateman formation bedrock and weakly cohesive soils might be other important factors. Getting away from Bateman Ridge the number of large slides was less and no major torrents developed.

In the period of 7/1965 to 8/1970 a lot of major road construction and increased harvesting was occurring. Skyline yarding was dominant. Road related slides were at a high level. Sidecasting on steep slopes contributed to a number of large debris avalanches, the most notable examples, on BLM surfaces, being the BLM 25-7-5.1 road in Sections 3 and 10, T24S, R8W (Rader Creek) and the BLM 24-8-26.4 road in the Miner and Caseknife compartments.

In the period of 8/70 to 5/78 the same trend as in the previous period continued. The BLM roads 24-8-34.1 and 25-8-4.0 of the Little Wolf division are examples of large road drainage and sidecast failures.

In the period of 5/78 to 5/83 road construction declined significantly. No major arterial roads were added, only a scattering of spurs. The practice of sidecasting was not evident. The longest road constructed was the 25-8-25.1 road in the Cougar division. The greatest amount of harvesting was in the Rader Creek division.

The evidence seems to point to a significant precipitation event in the local area in the early 1980s. There was a significant jump in the frequency of landslides. Four large debris avalanche-torrents approaching the order of those of the 64 flood event occurred in the Cougar, Upper Cougar and Rader Creek compartments. A number of smaller ones also developed. An earth flow of nearly two acres happened in undisturbed old growth on the north facing slope in the SE1/4 Section 9, T24S, R8W (Rader Creek division). A large slump-earth flow appeared in old growth above a tributary of Little Wolf Creek (east of center of Section 3, T25S, R8W) during this period. It grew to nine acres by 1989 and is still active today, putting sediment into the creek.

During the period of 5/83 to 6/89 a fair amount of road construction and harvesting occurred. Five new roads and their spurs were constructed in the southern part of the WAU: 25-8-25.2 road, a midslope road in the S1/2 of Sec. 14, T25S, R8W; and extensions of the 25-8-22.0, 25-7-21.0 and 25-8-9.2 roads. A number of spurs were constructed in the Miner Creek and Rader Creek compartments. The practice of sidecasting was not evident in any of these roads and spurs. A large clearcut was created in the S1/2 of Sec. 14, T25S, R8W (Cougar, Upper Cougar and Extra Cougar) and another was created in the S1/2 of Sec. 10, T25S, R8W (Lower Little Wolf). A number of small clearcuts were created in the Miner Creek and Rader Creek compartments.

Landslide activity decreased substantially in this time period. Although, there were still pockets of considerable activity. Activity again was most numerous on the very steep headwater slopes of Upper Cougar below Bateman Ridge. Here one pretty impressive road related debris torrent raced down a steep gradient draw. Fourteen percent of the slides were associated with established forest (Table II-4).

During the period of 6/89 to 7/94 a fair amount of road construction was done. New roads and their spurs were constructed on and near ridgetops along the border of Upper Cougar and Lower Little Wolf compartments in Sections 15 and 16, T25s, R8W, along the border of Upper Wolf and Rader Creek compartments in the W1/2 of Section 12 T24S, R8W and in the Rader Creek compartment extending beyond the 24-8-1.4 road in Sections 11 an d 14, T24S, R8W. Other new roads are spurs in the N1/2N1/2 of Section 15, T25S, R8W in the Lower Little Wolf compartment and the 24-8-24.2 road in Upper Wolf compartment. The extent of clearcutting was relatively small.

Despite the amount of road construction, landslide activity decreased to the lowest level of the 42 year period. Only 12 slides were identified and none of them were large (Table II-3). This low number of slides may be due to a combination of prolonged drought, better road construction practices.

For the period of 7/94 to present the LAU experienced higher than normal rainfall with a couple of pretty exceptional storms. There has been definite increase in road problems caused by the weather but only two large road related landslides attributable to this period were noted in the field. The biggest was a large slump about 500 feet across at a saddle separating Upper Cougar and Lower Little Wolf drainages (SW1/4NW1/4 Section 15, T25S, R8W) caused by the overloading of a bench with cut waste on the Lower Little Wolf side of the ridge. The slump touched off a large earth flow below it. The other was an apparent earth flow into a tributary of Cougar Creek. Five medium sized in-unit slides were discovered.

Current Condition:

The current levels of erosion and mass wasting in the WAU is probably well below historic highs when large debris torrents occurred (wet season of 1964-65 and a wet season in the early 1980s), when large areas were ground based yarded (1950s and 1960s), when large scale road construction was on going before the best management practices of today were utilized (the late 1960s and the 1970s) and when large acreage were in young clearcuts (up to about 1983). While the healing process has sufficiently progressed so that there are not many large scale problems remaining, The cumulative effects of all the residual impacts spread throughout the WAU would still be significant. The roads would probably be the biggest impact today.

Little of the old landslide scars remain in a highly erodible state. Most of the scars seem to heal satisfactorily in five to seven years. Most road surfaces seem to do the same if traffic is kept off of them. The big majority of the old unsurfaced haul roads and skid trails are no longer an erosion problem, have revegetated to varying degrees and are blocked to traffic by understory and trees. Many of these will probably never be used again. The persistent state of heavy compaction and the resultant soil productivity loss and its effects on the hydrology is a more important issue with them. Soil productivity loss due to sliding may be locally important but is relatively small when spread throughout the WAU. An estimated 0.8 percent of the WAU area was directly impacted by recorded slides that occurred from the mid-fifties to the present.

There are some old unsurfaced roads and a number of newer unsurfaced spurs on BLM surface which have big erosion problems. There are also a number of localized areas with road slope stability problems including the big slump and earth flow in the Lower Little Wolf drainage.

Road cuts commonly are in soft, brittle siltstone and very fine sandstone bedrock and in the soils formed over them. These cuts tend to experience varying degrees of ongoing sloughing and ravel. There are many old and new roads which fit this category.

Figures II-11 through II-14 mark the location of current road problems which were noted recently in the field. Table II-14 and comments give a written description of the location and nature of the problem. Those of moderate priority for corrective action are marked with a check. Those judged to be high priority are marked with a double check. No check denotes low priority. The problems noted are only on those roads controlled by the BLM and on privately controlled roads where they are on BLM surface.

Table II-14. Current road problems location, road number, ownership and surfacing in the Rader-Wolf-Cougar WAU.

	ID No.	Compartment	Legal Description	Road No.	Ownership of Road
	6	Extra Cougar	SWNE Sec 19, 25S, 7W	?	Private/unsurfaced
✓	7	" "	NWSE Sec 19, 25S, 7W	?	BLM?/unsurfaced
	9	" "	NWNW Sec 19, 25S, 7W	?	Private/rocked
✓	10	" "	S½SE¼ Sec 13, 25S, 8W	25-7-19.0	BLM/unsurfaced
	27	Little Wolf	S½SE¼ Sec 1, 25S, 8 W	25-8-1.0	BLM/rocked
	35	Upper Cougar	SW¼ Sec 15, 25S, 8W	25-8-15.2?	BLM/unsurfaced
	37	" "	SWSW Sec 15, 25S, 8W	25-8-1.0	BLM/rocked
✓	44 to 46	Cougar	N½NE¼ Sec 23, 25S, 8W	25-8-22.0	Private/rocked
	48	Upper Cougar	SWSW Sec 15, 25S, 8W	25-8-1.0	BLM/rocked
✓	49	Little Wolf	NWSE Sec 1, 25S, 8W	24-8-36.0	BLM/rocked
	50	Little Wolf	SE¼ Sec 4, 25S, 8W	25-8-9.0	BLM/rocked
✓	51&52	Little Wolf	NENW Sec 9, 25S, 8W	25-8-8.1	BLM/rocked
✓	53	Little Wolf	NE¼ Sec 9, 25S, R8W	?	BLM/unsurfaced
	57	Lower Little Wolf	N½NW¼ Sec 15, 25S, 8W	25-8-15.5	BLM/rocked
	59	Little Wolf	S½NE¼ Sec 9, 25S, 8W	25-8-9.2	BLM/rocked
	60	Lower Little Wolf	N½NE¼ Sec 9, 25S, 8W	25-8-10.10	BLM/rocked
	61	Lower Little Wolf	NENW Sec 9, 25S, 8W	25-8-8.8	BLM/rocked
✓	63	Little Wolf	W½W½ Sec 1, 25S, 8W	25-8-1.2	BLM/unsurfaced
✓	69	Miner Creek	NESW Sec 35, 24S, 8W	24-8-36.0	Private/unsurfaced to lightly rocked
	70	" "	NW¼ Sec 35, 24S, 8W	?	BLM/unsurfaced
	71	" "	SESE Sec 35, 24S, 8W	24-8-36.0	BLM/rocked
✓	72&73	" "	S½ Sec 35, 24S, 8W	24-8-36.0	Private/unsurfaced to lightly rocked
	82&83	Little Wolf	W½ Sec 3, 25S, 8W	24-8-3.1	BLM/rocked
✓	86	" "	W½ Sec 4, 25S, 8W	24-8-4.0	BLM/rocked
✓✓	87	Caseknife	S½SW¼ Sec 33, 24S, 8W	24-8-34.1	BLM/rocked
✓	90	" "	N½N½ Sec 34, 24S, 8W	24-8-26.4	BLM/rocked
	92	Whiskey Ck	W½SW¼ Sec 27, 24S, 8W	24-8-28.0	BLM/unsurfaced
	95	" "	SW¼ Sec 28, 24S, 8W	24-8-26.4	BLM/unsurfaced
✓	96	Caseknife	SESE Sec 28, 24S, 8W	24-8-27.3	BLM/rocked
✓	101	" "	S½N½ Sec 33, 24S, 8W	24-8-27.3	BLM/rocked
	103A	Miner-Whiskey Ck	E½ Sec 27, 24S, 8W	24-8-27.1	BLM/rocked
✓✓	104	Miner Ck	E½ Sec 27, 24S, 8W	?	BLM/unsurfaced
✓	105	" "	S½NE¼ Sec 27, 24S, 8W	24-8-27.1	BLM/rocked
✓	106	Miner-Whiskey Ck	NE¼ Sec 27, 24S, 8W	bypassed segment of 27.1	BLM/unsurfaced
	107	" "	Sec 27, 24S, 8W	24-8-27.1	BLM/rocked
	110	Middle Wolf	S½SW¼ Sec 23, 24S, 8W	24-8-22.1	BLM/unsurfaced
✓✓	112A	Whiskey-Middle Wolf	SWSE Sec 22, 24S, 8W	24-8-35.1	BLM/unsurfaced
✓	113	Middle Wolf	SWSW Sec 23, 24S, 8W	24-8-22.1?	BLM/rocked w/2 unsurfaced ramps to landings
✓	114	Whiskey-Middle Wolf	SE¼ Sec 22, 24S, 8W	24-8-35.1	BLM/lightly rocked
	116	" "	SE¼ Sec 22, 24S, 8W	24-8-22.0	BLM/unsurfaced
✓	117	Whiskey Ck	SWSE Sec 22, 24S, 8W	?	BLM/unsurfaced
✓✓	121	" "	SESE Sec 21, 24S, 8W	?	Private/unsurfaced
✓	122	Whiskey Ck	NESE Sec 21, 24S, 8W	24-8-35.1	Private/lightly rocked
✓	123	Middle Wolf	NESE Sec 21, 24S, 8W	?	Private/unsurfaced
✓	127	Whiskey-Middle Wolf	Sec 17&20, 24S, 8W	24-8-20.0	BLM/rocked
	134	Whiskey Ck	NE¼ Sec 28, 24S, 8W	24-8-28.3	BLM/unsurfaced

✓	136A&B	" "	S½ Sec 21, 24S, 8W	24-8-21.2	BLM/rocked
✓	137	" "	SE¼ Sec 20, 24S, 8W	?	BLM/unsurfaced
	141	Middle Wolf	E½SE¼Sec 23, 24S, 8W	24-8-23.0	BLM/unsurfaced
✓	142	Upper Wolf	E½NE¼ Sec 23, 24S, 8W	24-8-23.2	BLM/lightly rocked & unsurfaced
✓	144	Middle Wolf	NENE Sec 35, 24S, 8W	24-8-36.1	Private/unsurfaced
	154	" "	SENW Sec 25, 24S, 8W	24-7-17.1	BLM/rocked
✓	156	" "	SENW Sec 25, 24S, 8W	24-7-17.1	BLM/rocked
	158&160	" "	NENW Sec 25, 24S, 8W	?	BLM/lightly rocked & unsurfaced
✓✓	164	Middle Wolf	NWNW Sec 25, 24S, 8W	24-7-17.1	BLM/unsurfaced
✓	172	Upper Wolf	E½SE¼ Sec 24, 24S, 8W	24-8-24.0	BLM/rocked
✓	173	" "	W½W½ Sec 19, 24S, 7W	24-8-24.2	BLM/rocked
	178	" "	NWNW Sec 19, 24S, 7W	?	BLM/unsurfaced
	180	" "	S½SE¼ Sec 18, 24S, 7W	24-7-18.3	BLM/rocked
✓✓	183		N½NE¼ Sec 18, 24S, 7W	24-7-17.2	Private/unsurfaced
✓	184	" "	SESE Sec 7, 24S, 7W	?	BLM/unsurfaced
	187	" "	Center of Sec 7, 24S, 7W	?	BLM/unsurfaced
	188	" "	N½SW¼ Sec 7, 24S, 7W	?	?/unsurfaced
✓✓	190	" "	W½SW¼ Sec 7, 24S, 7W	?	BLM/unsurfaced
	193F	Rader	NWNW Sec 13, 24S, 8W	?	BLM/worn rock
✓✓	194	Upper Wolf	W½NW¼ Sec 13, 24S, 8W	24-8-23.2	BLM/unsurfaced
✓✓	195A	Upper Wolf	NWNW Sec 13, 24S, 8W	24-8-23.2	BLM/unsurfaced
	195C	Upper Wolf	SE¼NE¼ Sec 13, 24S, 8W	24-8-23.2	BLM/unsurfaced
	196B	Upper Wolf	NENW Sec 13, 24S, 8W	24-8-13.0	BLM/unsurfaced
	198	Rader	SWSE Sec 01, 24S, 8W	24-8-1.0	Private/unsurfaced
✓	199	Rader	SESW Sec 01, 24S, 8W	24-7-18.0	BLM/rocked
✓	202	Rader	NWNE Sec 11, 24S, 8W	24-8-1.3	BLM/unsurfaced
✓✓	208	Rader	SWSE Sec 11, 24S, 8W	?	Private/rocked
✓✓	210	Middle Wolf	N½S½ Sec 23, 24S, 8W	24-8-23.3	Private/unsurfaced & lightly rocked
✓	211	Rader	NENW Sec 23, 24S, 8W	24-8-23.5	BLM/rocked
✓✓	212	Rader	NWNW Sec 23, 24S, 8W	24-8-23.5	BLM/rocked
	214	Rader	N½ Sec 23, 24S, 8W	24-8-23.5	BLM/rocked
✓✓	215	Rader	SESE Sec 15, 24S, 8W	?	Private/unsurfaced
✓✓	216B	Middle Wolf-Rader	W½ Sec 15, 24S, 8W	24-8-23.5	BLM/unsurfaced
	220	Rader	E½ Sec 15, 24S, 8W	24-8-15.0	BLM/rocked
	226	Rader	NWSE Sec 10, 24S, 8W	25-7-5.1	BLM/asphalt
✓	237	Rader	E½ Sec 03, 24S, 8W	?	BLM/unsurfaced
✓✓	238	Rader	NE¼ Sec 03, 24S, 8W	24-8-10.1	BLM/rocked
✓✓	242	Rader	W½SW¼ Sec 3, 24S, 8W	?	BLM/unsurfaced
✓✓	243	Rader	NWNW Sec 3, 24S, 8W	?	BLM/unsurfaced
	244	Lower Wolf	SWSE Sec 36, 24S, 8W	25-7-5.1	BLM/asphalt
✓✓	245	Lower Little Wolf	SWNW Sec 15, 25S, 8W	?	Private/surfaced
✓	246	" "	SWNW Sec 15, 25S, 8W	25-8-15.0	BLM/unsurfaced
✓✓	247	Lower Wolf	NESE Sec 01, 25S, 8W	24-8-36.0	BLM/asphalt

Notes: I. D. number refers to unique field note number.
no checkmark = low priority
✓ = medium priority
✓✓= high priority

ID No. Comments

6	Unsurfaced road with shallow ruts (low priority)
7	Unsurfaced road with 4 to 18 inch deep ruts on steep graded first segment. Runoff from the ruts are cutting into surface of BLM rocked road 25-7-19.1.
9	New rocked road with no designed ditchline; The cutbank sloughed at first segment into a ditch crudely dug to handle flow from a seep burying it. Some of the flow was being diverted onto the roadbed and then onto BLM rocked road 25-7-19.0.
✓ 10	Unsurfaced road with erosion ruts up to 17 inches deep; The last segment in a wet area has tension crack with up to 4 inches of displacement in the roadbed.
27	Sloughing cutbanks
35	Unsurfaced road with shallow erosion ruts and low spots. It is getting vehicle traffic (low priority)
37	Small roadcut slide into road blocking drainage; Here the roadbed is wet and rutted.
✓ 44 to 46	Large roadcut in finely bedded, weakly cemented fine sandstones and siltstones which has bad dry ravel into ditch and roadbed and a cutslope failure which buried a culvert inlet. A recent earthflow (40 ft wide & 70 ft. long) initiated at the culvert outlet. The culvert is now suspended as a cannon culvert.
48	Road drainage disrupted by large blowdown.
✓ 49	Water is ponding in ditch where road was repaired by filling with rock an earthflow escarpment which took out the outer part of the road. No culvert was placed here even though a draw intersects the road at this point. Settling has created a 1 ft escarpment along the outer edge of the roadbed. A fresh slump scarp is located 50 ft up the draw from the road.
✓ 50	Six small cutslope slides (earth slipping off hard bedrock) causing road drainage problems (soft spots, rutting and subsidence.)
✓ 51&52	Cutslope failure is covering two thirds of road surface and is blocking drainage causing soft, rutted surface. In another part is a smaller failure and ravelly siltstone bedrock.
✓ 53	Unsurfaced road has up to 10 inches deep erosion ruts. It gets occassional traffic. Little vegetation is growing in its bed.
57	Bare cutslopes with moderately deep soils over siltstone.
59	Bare cutslopes
60	Bare cutslopes similar to #57. One small cutslope failure filled ditch but as of yet not causing an erosion problem. Shallow erosion ruts present in rocked roadbed.
61	Bare cutslopes similar to #57.
✓ 63	Unsurfaced road getting four wheel traffic. Erosion ruts to 9 inches and wet spot present.
✓ 69	Small debris torrent in draw blocked road with about 5 ft high deposit. The torrent did not progress beyond road. Streamflow is blocked from going through culvert and has cut a path across the road.

70 Steep graded first segment of an unsurfaced road which has erosion ruts 2 to 5 inches deep.

71 Approximate location of moderate size road cuts where ravel is undercutting the deep soils there.

✓ 72&73 Unsurfaced or lightly surfaced road which has a scattering of shallow ruts outside of wet low spots and ruts up to 12 inches in the wet low spots. Small berms have developed on outside of road from grading.

82&83 Roadbed with very worn rock is rutting and washing in places. Steep sided gully formed up upstream of culvert (83) where apparent road cut waste site was built up across draw. The roadbed is slightly sunken and ruttted at crossing.

✓✓ 86 Numerous past sidecast failures occurred. A few slabs of sidecast are in progress of failing. At one site a 40 ft wide slab has slipped 6 inches displacing about ½ of roadbed width. Rock falls are occurring at the steep rocky headwall. Big colluvial slopes have encroached on the road where the bedrock is brittle siltstone. In one spot colluvium buried the ditch, culvert, and part of the road causing a fill failure and cannon culvert on the other side. It could still fail some more.

✓✓ 87 Large slump approximately 500 feet long whose scarp follows the road splitting the roadbed in places and in other places displacing the whole roadbed at the ditchline. The downward displacement averages about 7 feet. The road's NW facing cross slope lines up pretty well with the geologic dip.

✓ 90 Cutbanks have a ravel problem and may be a good candidate for hydromulching; Depressed tire tracks channeling water and causing some rilling.

92 Unsurfaced road in outplanting site has shallow erosion ruts. Grass covers surface outside of tracks (low priority).

95 Similar to #92. Road is getting difficult to travel due to low lying branches of adjacent trees. Still gets occasional traffic (low priority).

✓ 96 Cutbank problems similar to #90; Candidate for hydromulching.

✓✓101 Two rockfall slides (passable) where the bedrock is hard and massive sandstone; Dry ravel problem where finely bedded. Some sunken grades on outside edge of road suggests possible future sidecast failures on these very steep slopes.

103A Rilling in bed of steeply graded rocked road.

✓✓104 Unsurfaced road with moderate grades has erosion ruts up to 15 inches deep into siltstone bedrock. It is getting traffic.

105 Rilling in bed of steeply graded rocked road. It may be in part due from drainage off of unsurfaced road #106.

✓106 Steep graded first segment of unsurfaced road at through cut is eroding.

107 In general the road has bare cutslopes experiencing ravel and sloughing. It may have a moderate need for hydromulching.

110 Moderately steep graded unsurfaced road with shallow rill ruts between grass covering.

✓✓112A Steep gradient through road which is eroding severely. It has no vegetation growing on surface and has big ruts. It gets traffic.

✓113 One unsurfaced ramp onto landing is eroding.

✓114 Lightly rocked through road experiencing some rutting and has wet low spots. About 20 percent of its length is essentially unsurfaced. The next segment to the west is the bad steep graded segment of #112A.

116 Unsurfaced spur experiencing some erosion. Grass is growing between the tracks. It is getting traffic.

✓117 Unsurfaced spur experiencing light erosion. Grass is growing between the tracks. It is getting traffic.

✓✓ 121 Unsurfaced road accessing private property has erosion ruts up to 12 inches. Sediment layden drainage from it is causing ditch erosion on the BLM 24-8-27.0 road.

✓122 The approach to the BLM rocked portion is experiencing the most erosion. The rest is experiencing moderate amounts.

✓123 Unsurfaced except for the lightly rocked approach to the BLM rocked portion. It has an erosion problem and is getting traffic.

✓127 Rocked rocked on Bateman Ridge with depressed tracks and rutted low spots. The rock is essentially gone in the low spots. Grass is growing between tracks. Sedimentation is probably not a problem.

134 Unsurfaced road past outplanting site is experiencing some erosion and gets occasional traffic.

✓✓136A&B Large bare siltstone cutbanks which have experienced backwasting and ravel. The siltstone is fractured.

✓137 Some cutbanks like 136A&B.

141 Unsurfaced road getting some erosion and rutting through recent vehicle traffic. The first segment crosses what appears to be a somewhat poorly drained soil. A few tiny cutslope failures have occurred (low priority).

✓✓ 142 Four fill failures slumped into the riparian zone of "Upper Wolf Creek". The first probably occurred in the 1995-96 wet season. It is 50 ft wide and cut 8 to 10 ft into the road surface. The second is an older failure which is well vegetated. The third occurred at a culvert crossing in a boggy, rutted roadbed being fed by drainage captured from a draw. The culvert is now a cannon culvert and leaking. The fourth failure ate 12 feet into the roadbed. It is now well vegetated. The first part to the first failure is lightly rocked. Beyond that it is unsurfaced. Traffic occasionally occurs to a little past the first failure. The road surface appears generally wet.

✓ 144 Rocked surface is almost totally gone. The road is boggy, rutted and experiencing some erosion due to captured drainage. It is in the riparian zone of Wolf Creek and gets occasional traffic.

154 Small cutbank slide filling ditch.

✓ 156 Large cutslope with ravel problems. One sloughage and one rockfall has buried ditch.

158&160 The first part of the road through the BLM outplanting site is lightly rocked and the latter part is unsurfaced on moderate grades. Some rutting and rilling present. It gets occasional traffic.

✓✓ 164 Steep graded unsurfaced road with erosion ruts up to 15 inches deep, some into soft sandstone bedrock. Some ruts are grassed over. Others are raw and eroding. Sediment layden drainage travels down the rocked portion below and adjacent unsurfaced spur.

✓ 172 Fairly large cutbanks are experiencing ravel which are burying the ditch in a number of spots.

✓ 173 Bare eroding cutbanks in deep reddish soil and ditch erosion (hydromulch candidate).

178 One short stretch of rilling on a trail which is no longer accessible to standard size vehicles. It is apparently not getting traffic.

180 Some ditch erosion.

✓✓ 183 Unsurfaced road on moderate grades is getting erosion ruts and apparent frequent traffic. No vegetation is in the road bed.

✓184 Unsurfaced spur on a steep grade has four parallel erosion ruts and is getting traffic. Grass is growing between the ruts.

187 Unsurfaced road on moderate grade has shallow rilling at its approach to the 24-7-18.0 road. Beyond this it is nearly all grassed. It gets occassional traffic and my be subject to damage if traveled on while wet. The canopy is closing over making travel increasingly difficult (low priority).

188 One short segment of an unsurfaced road has water channeling in rills (one 15 inches deep & 3 feet wide. Inaccessible as long as woody debris blocks entrance).

✓✓ 190 Unsurfaced spur with erosion ruts up to 8 inches and rills channeling water off landing. At the roads intersection with the rocked 24-7-7.4 spur the drainage ditch culvert beneath the unsurfaced road entrance is exposed (4inches).

193 Road with very worn, mushy rock with track depressions and ruts channeling water; some roadcut sloughage.

✓✓ 194 The first segment of the unsurfaced road is moderately steep graded and is eroding badly. It has four erosion ruts across that are up to 10 inches deep. It appeared to get occasional traffic before a recent old growth blowdown across it. The next segment has a scattering of erosion ruts with depths to 5 inches.

✓✓ 195A Unsurfaced road is getting drainage from segment 194A causing ditch erosion. Erosion ruts are present, some healing over with grass. One culvert is exposed in roadbed (12 inch wide strip) and with a hole in it. Road grades are moderate.

195C One fill failure exposes a cannon culvert. It does not appear to be enlarging.

196B Moderately large cutbanks with sparse vegetation growth and some backwasting.

198 Old unsurfaced road narrowed down to a trail with a narrow strip of unhealed, eroding ground.

✓ 199 Slump on fill side of rocked road about 120 feet wide and 5 feet into the roadbed. There is up to 15 inches vertical displacement and up to 24 inches horizontal displacement. It probably occurred this wet season.

✓ 202 Dirt road experiencing moderate erosion problems (last segment of otherwise rocked road).

✓ 208 New rocked road accessing private land which has ravel encroaching on road and filling ditch (if there was ever one). At the bend in the road the drainage is being diverted across the road which caused a slump in the fill. Other drainage is flowing onto an open area where it and several other roads meet dumping water and sediment down the adjacent slope. Note that the location of the road on my map is a little off. The segment of concern is in BLM Section 11 and not private Section 14.

✓✓ 210 Approximately first 350 feet of road is unsurfaced and moderately graded. It has erosion ruts 3 to 7 inches. Grass is growing outside the ruts. Drainage and sediment from the ruts enter the drainage ditch of the BLM 24-8-23.5 road which then empties directly into Wolf Creek. This ditch also captures the drainage of a draw which is located between the two roads. Beyond the unsurfaced portion, the 23.3 road is lightly rocked and has shallow track depressions which probably have a little erosion.

✓✓ 211 Substantial fill failure at a draw crossing leaving a cannon culvert and a raw scarp. The culvert is leaking. Water was seeping through the scarp at the time of observation.

✓✓ 212 Substantial cutslope failure in deep soils buried ditch and created a 5 ft. wide pond. The shoulder of the road across the slide is wet, soft and rutted with tire tracks.

214 Road is generally moderately steep graded and has large cutbanks, some of which backwasted quite a ways upslope in the past. One recent small failure filled in ditch. Some of the cutbanks are bare. They occur in siltstone bedrock. Some washing of surface on the steep grades.

✓✓ 215 Unsurfaced road grading moderately steep to the 23.5 road. The road is rutted with little grass growing in between the tracks. Drainage and sediment is entering the 23.5 ditch. (Note: Section line does not slope down to include #215 in Section 15 as it should on the GIS map.)

✓✓ 216B Unsurfaced road has moderately steep grades and high surface erosion for the first 500 feet. Sediment from it enters into the drainage ditch for the rocked 23.5 road below. The next 3800 ft has gentler grades and grass between mostly shallow ruts. The road gets traffic for these two segments. Beyond this the road has not been getting traffic and is in stable condition. Roseburg Resources has proposed upgrading the road to Bateman Ridge.

220 Moderate size cutbanks in siltstone bedrock are experiencing moderate levels of ravel. The rock on this road is quite worn and low depressions are present.

226 Moderately large cutbank experiencing ravel.

✓ 237 Unsurfaced road built in the 1980's has been blocked to traffic by a berm, rootwad and a log. Beyond these obstacles the surface is grassed from what limited distance I could see from the rootwad. The first 200 ft to the berm is rilled, devoid of vegetation and getting traffic.

✓✓ 238 A large blowout of the road occurred in probably the 1994-95 wet season at its crossing of a fork of Rader Creek. The approximately 20-25 feet deep fill was almost completely removed and the six foot culvert deposited just downstream. The approach of the road is undercut and poses a hazard to vehicles. The exposed earth is still pretty much unvegetated and eroding. Young, steep 3 ft high inner gorge channel has been cut by the stream.

✓ 242 Moderately steep graded unsurfaced road with four erosion ruts across the surface in soil material. It is getting traffic.

✓ 243 Unsurfaced road similar to #242. Roseburg Resources proposes to upgrade the road with rock.

244 Medium sized slide burying the ditch of the 25-7-5.1 asphalt road.

✓✓ 245 Segment of rocked which was greatly impacted by a 500 ft wide slump caused by overloading a bench with wasted material from the road construction in the winter of 1995. Displacements were upwards of 10 ft. along the head scarp where the road is located. A number of tension cracks and secondary scarps were created on the bench below resulting in a large earth flow which impacted 25-8-15.0 road downslope from it. Most of the waste material was subsequently removed and the site seeded and mulch. The new road along the main scarp looked stable when observed for this watershed analysis. One wide tension crack above the earthflow scarp has opened up more, threatening to cause another substantial slab of earth to slip into the earthflow zone of depletion and possibly touching off a secondary earthflow. The whole site should be periodically monitored for any future movements. The earthflow is still pretty raw although some vegetative recovery has occurred. Water from a seep flows down from the base of the scarp.

✓ 246 Material from the earthflow of #245 traveled down a steep gradient draw and was deposited on the 25-8-15.0 road. Some bleeding off of it into the draw channel below was occurring when inspected in the spring of 1995.

✓✓ 247 A lot of sediment was entering the ditch of the 24-8-36.0 road from the large BLM rock quarry during an operation in it this spring. Hay bales were placed in the ditch. I did not have an opportunity to observe their effectiveness.

Steambanks in general seem to have only have scattered problems with substantial erosion, mass wasting and stability. Old debris torrent and flood scars where wide swaths of riparian zones were wiped out appear to be stable today based on aerial photo interpretation and the onsite investigations of two of them.

The near-future trend may be a large increase in timber harvesting on private lands. The biggest impacts to BLM surface may be new road construction to access these private lands. Water quality may lower in parts of watersheds.

Reference Condition:

The reference condition before the influence of white settlement and exploitation appears to be forest typically consisting of a patchwork of old growth stands and small polygons of younger even-aged stands created by burns. The overall character is old growth. Surface erosion and mass wasting were generally small components in the established stands. Erosion would increase after a burn but was probably short term and usually was only significant following a hot burn on steeper slopes. Landslides were rather infrequent (when compared to managed areas) and rarely large except where burns recently occurred on unstable ground and when catastrophic "100 year" precipitation events occurred. These larger precipitation events could spawn large debris avalanche - debris torrent combinations which would radically alter stream channels and riparian zones. The short- term impacts of these torrents to water quality were great but important long-term benefits were probably derived from input of rock fragments and woody debris.

The Bateman formation in general seems to be very prone to significant debris avalanches and torrents. The very steep slopes of the Tyee formation are also prone to these types of slides but in the WAU the magnitudes have not been as great as with the Bateman. The Elkton formation and the slopes in the

Tyee formation that are aligned with the dip are more prone to earth flows and slumps. In general the risk of landslides is low in the areas mapped 0 to 30 percent slope, moderate where mapped 30 to 60 percent, and high where mapped 60 to 90 percent on Figure II-3. Landslides originate most often in headwalls and concave swales.

Before first-entry harvesting, the surface horizons of these forest soils generally were friable and had granular structure (as opposed to very firm consistencies and platy structure of severely compacted ground). The organic matter content of the undisturbed forest soils were generally higher than those which suffered machanical displacement and erosion, especially from grounds based systems.

III. HYDROLOGY

The RWC in composed of two watersheds, select characteristics are presented in Table III-1.

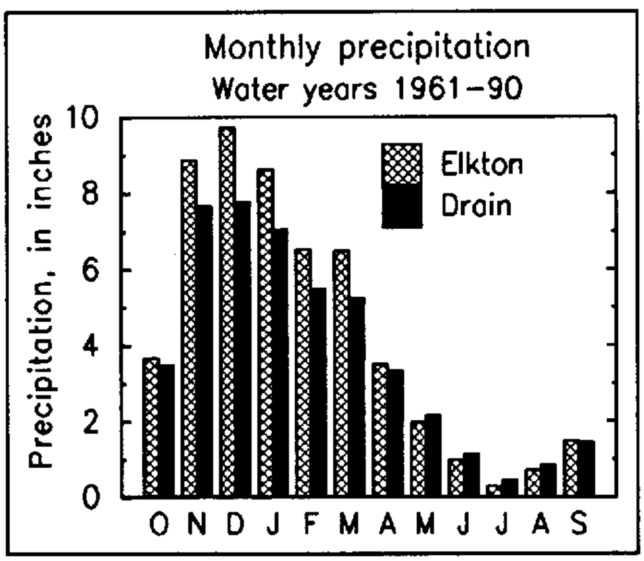
Table III-1. Watershed characteristics in GIS, changes to roads based on interpretations made from aerial photos in parenthesis.

Compartment	Area (mi^2)	Road (mi)	Road Density (mi/mi^2)	Stream (mi)	Drainage Density (mi/mi^2)	Number of Stream Crossings by Roads	Aspect (% of Total Watershed)	Stream Order
Case Knife	2.1	5.0 (9.4)	2.4 (4.5)	9.1	4.3	0	SE (18) NW (18)	4th
Little Wolf	5.5	18.7 (23.9)	3.4 (4.3)	26.6	4.8	10	SE (17.5) S (17)	5th
Lower Little Wolf	2.7	5.7 (10.5)	2.1 (3.9)	13.2	4.9	0	N (17) SE (17)	4th
Lower Wolf	3.2	11.1 (21.3)	3.5 (6.7)	14.9	4.7	10	NE (15) E (15) SW (15)	6th
Middle Wolf	5	18.7 (23.2)	3.7 (4.6)	20	4.0	5	SW (17)	6th
Miner Creek	1.6	8.2 (14.1)	5.1 (8.8)	7.8	4.9	5	E (15)	5th
Rader Creek	8.6	33.6 (43.5)	3.9 (5.1)	44.1	5.1	11	E (17)	5th
Upper Wolf	3.8	17.8 (26.7)	4.7 (7.0)	17.6	4.6	11	W (18)	5th
Whiskey Creek	4.3	16.9 (20.4)	3.9 (4.7)	19.6	4.6	7	S (19)	5th
Cougar Creek	5.4	20.4 (23.2)	3.8 (4.3)	28.5	5.3	10	NE (20)	4th
Extra Cougar	2.5	11.0 (11.9)	4.4 (4.8)	13.8	5.5	5	W (21)	5th
Upper Cougar	3.9	12.3 (17.9)	3.2 (4.6)	27.1	6.9	8	SE (18)	4th
WAU	51.60	180.4 (246.0)	3.7 (4.8)	243.30	4.7	82	--	6th

Climate

The RWC has a Mediterranean type of climate, characterized by cool, wet winters and hot, dry summers. The nearest weather stations, used to characterize precipitation and temperature for the WAU, are in Drain to the northeast at an elevation of 292 ft and in Elkton to the north at an elevation of 120 ft. They are NOAA weather stations and were selected because they are close to the study area and they have long term data available. Differences in precipitation and temperature should be expected throughout the watershed due to topographic variation, for example, precipitation is known to be dependent on elevation due to orographic effects. The climate data presented are 1961-90 mean data from Owenby and Ezell (1992). Annual precipitation ranges from 46 inches at Drain to 53 inches at Elkton, about 85% occurs from October to April; summer precipitation averages about 6 inches (Figure III-a). Annual precipitation in the RWC probably ranges from 50 inches at the outlets to the Umpqua River to 70 inches at the upper most elevations. Precipitation occurs mostly as rainfall since little of the study area is above 2,000 ft.

Figure III-a. Comparison of monthly precipitation at Elkton and Drain, Oregon for water years 1961-1990.



Normal summer temperature data for Elkton and Drain is shown in Table III-2. Summer maximum temperature is typically in the low 80s °F and winter minimum temperature is in the mid 30s °F.

Table III-2. Comparison of average summer temperatures (°F) at Elkton and Drain, Oregon for 1961 to 1990.

Month	Elkton			Drain		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
June	77.3	49.1	63.3	75.9	48.0	62.0
July	83.5	51.3	67.4	82.8	49.9	66.4
August	84.3	51.9	68.1	83.1	50.2	66.7
September	79.4	48.6	64.0	77.9	46.1	62.0

Streamflow

Streamflow have not been monitored in the RWC. Three sites in the Elk Creek drainage are being used to characterize the streamflow in this watershed analysis. Streamflow for these sites are representative of the flow conditions found within the RWC. These sites were selected because they are located close to the study area, have a long period of record, and no other data are known to exist.

Elk Creek near Drain (Station Number 14322000)

Continuous streamflow data were collected on Elk Creek near Drain for the water years 1956 to 1973. There was no regulation of flow above the gage; however, there was small irrigation diversions and the municipal supply for the town of Yoncalla is diverted from Wilson Creek, upstream. The gage was at an elevation of 306 ft; located 1.7 mi southeast of Drain, 0.2 mi downstream from Yoncalla Creek, with an upstream drainage area of 104 mi^2. The base discharge (annual maximum) is 3,100 ft^3/s. The average slope of the watershed above the gage is 28 ft/mi and has a length of 19.5 mi. The average basin elevation is 1,015 ft.

Elk Creek near Elkhead, Oregon (Station Number 14321400)

Continuous streamflow data and crest-stage data were collected on this site. Before September 1, 1968, there was a non-recording gage at a site 20 feet upstream of the current location, at a datum of 462.29 ft. The gage period of record is January to August 1968 (gage heights and discharge measurements only); and September 1968 to September 1970; and October 1986 to the current year. There was no regulation on this drainage from

1968-1971. There were irrigation diversions above the station from 1968 to 1971. No record of regulation or diversions were noted for the station after 1971. The drainage area for the gaging station is 28.7 mi^2. Base discharge is 820 ft^3/s. The datum of the gage was 463.99 ft above mean sea level.

Pass Creek near Drain, Oregon (Station Number 14322400)

Crest-stage data have been collected at this site from 1956 to 1967. The drainage area for the gaging station is 61.90 mi^2. The average slope of the watershed is 23 ft/mi and has a length of 13.2 mi. The average basin elevation is 800 ft. The datum of the gage is 302.06 feet above mean sea level.

The extremes of the daily discharge as published by the USGS by year are shown in Table III-3. Instantaneous peak flow is determined from the maximum or minimum gage height of the day. Daily flow is determined from the average gage height for the entire day.

According to Moffatt et al. (1990) the average discharge for 18 years on Elk Creek near Drain was 222 ft^3/s (165,900 acre-ft/yr). Maximum discharge was 15,000 ft^3/s on February 10, 1961, with a gage height of 23.7 ft. Statistical summaries compiled by Moffatt et al. (1990) for the period of record (1956-1973) are shown in Table III-4. These data are based on mean daily discharge; therefore, the mean annual flow using this method is 218 ft^3/s. Statistical summaries for Elk Creek near Elkhead from 1968-1994 were compiled by Hubbard et al. (1994) (Table 4). Maximum discharge was 2,320 ft^3/s on January 10, 1988, and had a gage height of 6.77 ft; however, the maximum gage height for the period of record came from a crest-stage gage and measured 7.74 ft on December 21, 1969. Minimum discharge was 0.15 ft^3/s on August 28, 1994.

Table III-3. Annual streamflow in ft^3/s for select gaging stations.

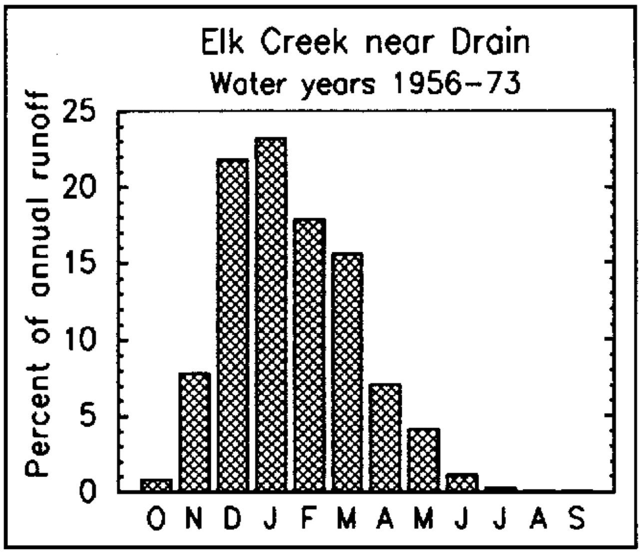
ELK CREEK NEAR DRAIN				ELK CREEK NEAR ELKHEAD				PASS CREEK	
WATER YEAR	INST PEAK FLOW [A]	ANN. MAX [B] DAILY Q	ANN. MIN [C] DAILY Q	WATER YEAR	INST PEAK FLOW [A]	ANN. MAX [B] DAILY Q	ANN MIN [C] DAILY Q	WATER YEAR	INST PEAK FLOW [A]
1956	9100	–	1.8	1969	1200	653	1.2	1956	5410
1957	4710	–	1.3	1970	2020	1280	.93	1957	2590
1958	7960	–	.7	1971	1400	1020	1.3	1958	5860
1959	7080	–	.5	–	–	–	–	1959	3850
1960	3930	–	.9	1987	1820	833	.61	1560	1900
1961	15000	11200	0	1988	2320	1400	.57	1961	10300
1962	11100	8400	0	1989	2270	1170	1.2	1962	3980
1963	4110	3510	0	1990	1170	444	.96	1963	2900
1964	12300	6470	.3	1991	558	398	.85	1964	6260
1965	10300	7610	0	1992	552	361	.54	1965	8450
1966	9660	6110	0	1993	493	418	.91	1966	4030
1967	3260	2150	.02	1994	259	209	.22	1967	1330
1968	2150	1800	.03						
1969	4830	3360	.03						
1970	7530	4930	.02						
1971	5490	4120	.65						
1972	7660	5550	.03						
1973	1460	1250	.02						

[A] Instantaneous peak
[B] Maximum daily discharges for the water year (highest daily mean)
[C] Minimum daily discharges for the water year (lowest daily mean)

Table III-4. Monthly and annual statistics of discharge in ft^3/s.						
Elk Creek near Drain for 1956 to 1973						
Month	Minimum	Year	Maximum	Year	Mean	Standard Deviation
Oct	5.5	1959	99	1957	20	23
Nov	8.6	1960	611	1962	207	177
Dec	32	1960	1870	1956	559	473
Jan	66	1963	1210	1964	597	378
Feb	126	1973	1370	1961	504	317
Mar	83	1965	807	1961	400	232
Apr	62	1966	649	1963	189	141
May	18	1966	361	1963	105	86
Jun	6.7	1966	63	1958	28	14
Jul	0.9	1973	17	1963	7	5.1
Aug	0.1	1966	11	1968	2.4	2.6
Sep	0.9	1965	11	1978	3.9	3.0
Annual	106	1973	404	1956	218	69
Elk Creek neer Elkhead for 1968 to 1994.						
Oct	1.5	1988	16.3	1969	5.6	
Nov	3.7	1994	113	1969	52.4	
Dec	15.6	1990	194	1969	106	
Jan	35.4	1992	253	1970	139	
Feb	31.1	1988	191	1979	89.5	
Mar	19.2	1992	184	1972	85.9	
Apr	21.0	1987	133	1993	56.4	
May	8.2	1987	67.9	1991	28.2	
Jun	3.3	1992	71.7	1993	15.3	
Jul	1.6	1994	7.7	1993	4.0	
Aug	0.5	1994	5.2	1993	1.8	
Sep	0.4	1994	4.0	1971	1.9	
Annual					45.9	

The average percent of annual runoff for Elk Creek near Drain from Moffatt et al. (1990) is shown in Figure III-b, it ranges from 23.2% for January to 0.1% for August and September, and 97.5% occurred from November through May. Streamflow in the RWC is assumed to be represented by the Elk Creek gaging stations. We should expect most of the streamflow to occur from November through May with the maximum in January. The streamflow differs from Elk Creek near Drain in that we should expect streamflow throughout the year in the lower reaches of RWC, except in very dry years and only for short periods of time, probably up to a week in August or a few days in July or September. This would be similar to Elk Creek near Elkhead. Elk Creek near Drain drys up for short periods of time almost every year in summer months, probably due to a large aquifer system where most of the water travels underground then resurfaces downstream. Much of the streamflow in the RWC is over bedrock; therefore, can not go underground.

Figure III-b. Percent of monthly runoff at Elk creek near Drain for water years 1956-1993.



The flood frequency for Elk Creek near Drain determined by Friday and Miller (1984) is presented in Table III-5. They did not estimate recurrence intervals of 50 and 100 years because the period of record was not long enough. Harris et al. (1979) presented discharges for selected flood-frequencies at gaging station using a different method that compares well to Friday and Miller (1984). These data are also presented in Table III-5 and include the discharges for flood frequencies at the Pass gaging station. Discharges for flood frequencies at the Elk Creek near Elkhead gaging station were not available in the previously mentioned publications.

Table III-5. Magnitude and probability of instantaneous peak flow.							
ELK CREEK NEAR DRAIN, OR # 14322000: 1956-1973 Friday and Miller (1984)							
RECURRENCE INTERVAL, in years	1.25	2	5	10	25	50	100
ANNUAL EXCEEDENCE PROBABILITY	80%	50%	20%	10%	4%	2%	1%
DISCHARGE, in ft^3/s	3,580	6,110	10,500	14,000	19,100	--	--
ELK CREEK NEAR DRAIN, OR # 14322000, Harris et. al (1979)							
RECURRENCE INTERVAL, in years		2	5	10	25	50	100
ANNUAL EXCEEDENCE PROBABILITY		50%	20%	10%	4%	2%	1%
DISCHARGE, in ft^3/s		5,600	10,600	14,900	21,500	27,300	33,800
PASS CREEK near Drain # 14322400:							
RECURRENCE INTERVAL		2	5	10	25	50	100
ANNUAL EXCEEDENCE PROBABILITY		50%	20%	10%	4%	2%	1%
DISCHARGE (ft^3/s)		4040	6720	8780	11700	14100	16700

Significant recurrence intervals for major flows for Elk Creek near Drain and Pass Creek were extrapolated from the above tables. The Elk Creek near Elkhead recurrence intervals were calculated from a Log Pearson Type Iii Distribution computer model and rounded. The top five flows for each station were select and given in Table III-6.

Table III-6. Recurrence intervals for gaging stations.

ELK CR NEAR DRAIN			ELK CREEK NEAR ELKHEAD			PASS CREEK		
FLOW (ft^3/s)	DATE	RETURN PERIOD (year)	FLOW (ft^3/s)	DATE	RETURN PERIOD (year)	FLOW (ft^3/s)	DATE	RETURN PERIOD (year)
15,000	2/10/61	25	1,820	2/2/87	4	5,410	12/26/55	4
11,100	11/23/61	6	2,320	1/20/88	8	5,860	2/15/58	5
12,300	1/19/64	9	2,270	1/10/89	7	10,300	2/10/61	43
10,300	12/22/64	5	2,020	12/21/69	5	6,260	1/20/64	5
9,660	1/4/66	4	1,400	1/17/71	3	8,450	12/24/64	13

Geomorphology

Area for the RWC is given in Table III-1 and III-6. The area in Table III-1 is for each individual compartment the area in Table III-6 includes the contributing upstream area and should be used when estimates of total annual yield and flood potential are desired. The minimum flow of a larger watershed such as Lower Wolf will be more sustained than that of a small watershed such as Case Knife because of large ground-water storage. Streams on the very small watersheds may dry up entirely during dry periods. If the same amount of rainfall is uniformly applied over two watersheds of different size, peak flows will be greater on larger watersheds when measured in absolute flow units (ft^3/s). However, when measured in units per unit area (csm) peak flows are lower and later on larger watersheds. Small watersheds exhibit higher high flows and lower low flows. Small watersheds are more likely to receive precipitation and deliver it as runoff simultaneously, where as precipitation on large watersheds takes longer to reach the outlet from remote portions, thus not all of the watershed is contributing simultaneously to peak flow. According to Black (1991) maximum peak flows, decay time, total runoff time, and time of concentration increases as the size of the watershed increases.

Drainage density (Table III-1) can be related to erosion potential. Upper Cougar has the highest drainage density and Middle Wolf has the lowest. According to Chow (1964) the higher drainage density the more complex the watershed and the faster streamflow will respond to rainfall; therefore, soils can be expected to erode easily, slopes are steep, and vegetation sparse. It should be noted that not all lengths of natural streams that flow during winter rain storms may have been mapped; therefore, drainage density may be higher than that shown in Table III-1.

Wemple (1994) developed a process and investigated the effective extension of stream networks resulting from road drainage. She estimated that roads in her study area extended the stream network 60% over winter base flow stream lengths and 40% over storm event stream lengths. The road densities found in her study area were 1.6 mi/mi^2. Road density in the RWC are 2.1 to 5.1 mi/mi^2; however, not all roads are on GIS and the actual road density range from 3.9 to 8.8 mi/mi^2. With an increase in surface flow as a result of ditch lines in a watershed, the rain or melting snow gets into streams quicker. Road drainage is a major cause of increased winter peak flows in streams in our area. The majority of roads within the RWC are constructed with ditches and/or insloped road surfaces that are intended to control water flow from the road surface. Once it is in the ditch, much of the water reaches the local stream channel faster than in an unroaded situation. In fact, some ditchlines effectively function as stream channel, so the actual length of flowing "streams" during rain storms is extended in the form of road ditches. Stream and road lengths and densities for the compartments in the RWC are shown in Table III-1. The highest road density is found in Miner Creek and the lowest is found in Lower Little Wolf Creek. The highest drainage density is found in Upper Cougar Creek and the lowest is found in

Middle Wolf Creek. When the drainage density is increased by the construction of roads we can expect to see more runoff in the form of increased peak flows and greater increases in mean annual floods. Drainage basins with fewer streams per mi^2 will experience higher winter peak flows as a result of roads than basins that naturally have a lot of streams. There are fewer streams to handle the rapid runoff so streamflow increases are greater, potential leading to down cutting, bank failures, bed scour, and mass wasting where streams undercut adjacent slopes. The dominant factor affecting peak flows in these smaller basins is basically just how quickly the water gets to the channels. The problem is compounded when the ground is harvested by tractors which usually compacts soils, further adding to surface runoff. In addition, erosion of driven road surfaces varies greatly with the type and amount of traffic, season of use, and the type and quality of road surface material (Reid and Dunne, 1984).

Rosgen (1994) suggest the importance of assessing the magnitude of the mean annual flood (recurrence interval=2.33 yr) because most of the work of stream erosion (over time) is done by flows of moderate magnitude with recurrence intervals of one to two years. This is significant where excessive amounts of fine sediment are in transport through the stream system such as in the Cougar Creek watershed. Elevated peak flows in some of the smaller drainage may also hinder natural adjustment and recovery processes within the streams by preventing aggradation and sorting of bedload and by hindering revegetation and stabilization of streambanks, as evident in the Radar-Wolf Watershed.

The movement of water through the watershed is greatly influenced by the vegetation cover. Early stage stands are subject to earlier faster runoff as precipitation occurs resulting in direct surface runoff. Older stage stands are likely to have reduced overland flows. This is attributable to a higher water storage capacity within these stands. Water absorbency is enhanced with greater vegetation cover.

The number of stream crossings by roads that can be counted in GIS is shown in Table III-1, no field inspection has been conducted for these data. The actual number are most likely higher since many roads and first and second order streams have not been entered in GIS. The highest number are found for Rader and Upper Wolf Creeks and none are found for Case Knife and Lower Little Wolf Creek. The crossing density can be used for comparison and as an indicator of potential for culverts to plug.

Slope is important because it is a prime factor in infiltration capacity. Combined with elevation, slope can be an important factor in orographic effects, and combined with aspect, slope is also important in insolation considerations that play a role in evapotranspiration and snowmelt. At higher elevations, slopes are generally steeper and have lower infiltration rates and more rapid runoff. Soil depth tends to be less at higher elevations owing to shorter time for soil to form. The overall effect is that average annual runoff is greater from small, high-elevation, steep-sloped, thin-soiled watersheds. Aspect is the direction of exposure to solar radiation of a particular portion of a slope, and orientation is the general direction of the main stem of the stream on the watershed. A watershed with an east-west orientation is likely to have slopes that are predominately north and south in aspect. Aspect is important to insolation, south-facing slopes are drier than north-facing slopes, which are cooler. South-facing slopes are likely to have lower average annual runoff than other portions of the watershed. Aspect of each RWC compartment is shown in Table III-1.

Streams may be divided into sediment source areas, transport areas, and depositional areas based on the slopes or gradient of the stream channels. Much of the RWC was not inspected. High gradient streams are source areas for debris torrents one was visited on May 3, 1996. Medium gradient streams are transport areas that do not change significantly with time. These streams seem to be lacking in large woody debris (LWD). Sediment tends to pass through them rather than be deposited. In general, low gradient streams are the most likely to change due to deposition and erosion of sediments. These streams provide the best quality for fish habitat because they have meanders, under cut banks, deep pools, large amounts of downed logs, and gravel tend to accumulate in these reaches. This is not occurring in the RWC. Instead we find many stream channels have been eroded down to bedrock, probably due to increase peak flow from timber harvests and road densities and the lack of LWD because of previous stream clean out practices.

The stream order and lengths of stream in GIS for the RWC are presented in Table III-6. The stream order system was found to have some errors associated with it. Not all first order streams are in GIS because stream length was too small or the channel could not be defined; therefore, the number and length of first order streams (Table III-8) must be higher. A limited site inventory was done in April 1996. Some 1st order streams were not flowing. All 2nd order and higher were found to be flowing. Only about 20% of the streams were visited for these analyses. There are three lakes in GIS for the WAU; however, two are the Umpqua River and are not included as part of these analyses. The other one is a small lake in the Upper Wolf compartment.

Table III-8. Number and length of streams by stream order for RWC.				
Stream Order	Rader-Wolf		Cougar	
	Number	Length, in miles	Number	Length, in miles
1st & 2nd	524	114.2	296	52.2
3th	56	31.5	12	10.7
4th	12	13.6	3	4.6
5th	3	8.9	1	1.8
6th	1	4.7	0	0
Lakes - Ponds	1.00	0.10	0.00	0.00
Total	596.00	173.00	312.00	69.30

The bifurcation ratio (Horton 1945) using the perennial streams identified on the USGS 1:24,000 topographic maps was calculate at 4.4 for Rader-Wolf and 5.0 for Cougar. The higher the ratio the larger the potential peak flow thus the more potential there is for erosion and nutrient and sediment transportation. Normal ranges are from 3.0 to 5.0. High bifurcation ratios are found in steep regions with narrow valleys. Cougar Creek is relatively longer and thinner, runoff should take longer to reach the mouth of the watershed and peak flows should be lower under the same moisture conditions. According to Easterbrook (1969) the average slope of streams in a given drainage basin decreases with increasing stream order, and the average length of a segment increases with increasing stream order.

IV. VEGETATION

This chaptert will cover the Characterization, Current Condition, and Reference Condition as outlined in The Federal Guide to Watershed Analysis (USDA, et al. 1995) for the vegetation found within the RWC. It is based on existing forest inventory records, aerial photo interpretation, and surveys of natural and managed stands.

Characterization

Characterization of the vegetation includes a description of the arrangement of plant communities and seral stages across the landscape, and the processes that cause these patterns.

Location

The RWC is located on the east side of the southern Oregon coast range, approximately 15 miles west of Sutherlin, Oregon, and 50 miles from the Pacific Ocean. This is an area of highly productive forest soils, abundant rainfall, and long growing seasons. Douglas-fir forest in various stages of development are nearly continuous throughout the area.

Processes: Stand Development

The dominant physical process responsible for this type is fire. Fire is the major disturbance event that leads to regeneration of the Douglas-fir forest by removing the overstory shade and creating a bare mineral seed bed. If it were not for naturally occurring stand replacing fires this forest would consist predominantly of shade tolerant conifers. The frequency and intensity of fire is variable and dependant on landform and climate. In general, low intensity surface fires are more prevalent and create small, non-contiguous openings. Large, stand replacing fires are much more infrequent, with intervals estimated at 200 to 500 years. The result is a mosaic of single and multi cohort stands across the landscape.

Other disturbance events that add to plant diversity include landslides and other soil movements, storms, disease, insects, and climatic change. There is no evidence to suggest that any of these events are responsible for the creation of large openings, or major change in plant communities in recent time. However, the potential for large scale disturbance and change in plant communities as a result of any of these events certainly exists.

Following a major fire event the openings created are rapidly reestablished with the plants that existed prior to the disturbance. Roots and seeds that survive in the soil sprout and germinate soon after. Adjacent plants shed seed on these areas, and the process of regeneration begins. The progression is not so much a well defined succession of new plants as it is a reoccurrence of the previously established plants. The length of time required for Douglas-fir to reestablish and dominate is variable and dependent on seed source and the degree to which the site is occupied by other plants. Because of this the age of trees in natural stands is not even, but rather a range that may span 30 or more years. The term even-aged does not accurately define most natural stands. A better term may be ***single cohort*** and is defined as all the trees that have resulted after a single disturbance event (Oliver, et al. 1990). A *multi-cohort* stand is one where minor disturbance events have created smaller openings in a patch like nature and younger cohorts exist interspersed with much older cohorts.

Recently forest development has replaced fire as the dominant disturbance event. Logging, road building and planting has converted much of the old natural forest into young Douglas-fir plantations. To some extent clear cutting and burning mimics a major disturbance event, but there are some major differences. Some of the more obvious differences include the removal of large trees, the creation of young stands that are much more uniform and even-aged, and the lack of large snags, large defective trees, and coarse woody debris. In time this practice would likely result in the loss of stand structures associated with old growth forests.

Stand Structure Classification and Seral Stage

Structural and compositional characteristics will be used to define three distinct seral stages; early, mid and late. Each of these seral stages contain characteristic structure that can be defined. The reason for doing this is to allow for a comparison of the percent of area in each of the seral stages between the current and reference condition.

The early seral stage is the time when the available growing space is reoccupied and shared by many species of plants. These early plants are sometimes referred to as pioneers, and may be short or long lived. In plantations, these early plants compete with trees and are often removed as part of management. In natural stands, conifers become established and eventually expand to exclude many of the early plants so that eventually competition is primarily between trees.

The mid seral begins when trees and/or other plants have captured all of the available growing space. The area is fully occupied and new plants will normally not invade unless there is further disturbance. The dominant plants are competing with each other for the available growing space, often forming a continuous closed canopy that allows very little light to reach the soil surface. Surface vegetation and plants that can not maintain their position in the canopy die. Compositional and structural diversity is more limited than in the early and late stages. Growing space becomes available slowly as plants die from competition, and growth rates are slow.

Stand differentiation often begins in the mid seral stage of development. In natural stands, difference in the age, size, and genetic potential of trees, and the differences in microsite and the abundance and arrangement of other plants, leads towards stand differentiation.

In managed plantations trees are more uniform in size, age, spacing, and genetic potential. Other plants are often excluded as part of management. It is more likely that the trees in these stands will all grow up together and reach a condition where competition between trees results in substantially reduced growth. It probably takes much more time for stands in this condition to differentiate.

The late successional stage is the desired stand structure for LSR within the WAU. It is defined as having the following characteristic:

- Deep multiple canopy layers; This characteristic may not occur in nature on southerly aspects because of the frequency of fire. Typically two or more canopy layers exist until the younger cohorts reach heights equal to the older residual conifers.

- Diverse tree size, form and condition; Trees are not evenly spaced and may exist in clumps, and tree size and form are affected by this variable distribution and density. Trees that are open grown typically have large diameter stems and full crowns. Tall, cylindrical stems with narrow crowns are found when trees grow close together. Large old conifers are present. Many of the oldest conifers are fire scarred and hollow, have broken tops, and contain heart and butt rots.

- Canopy gaps and natural openings; Late successional forests contain openings. The degree to which a stand is open, and the size and spatial arrangement of openings depends on the processes that create them. Stand age, frequency and intensity of fire, disease, insects, wind, and soil movement all have an effect.

- Large snags in various stages of decay; Competition, fire, insects and disease are primarily responsible for the creation of large snags. This is probably a highly variable characteristic. Some large snags are present in late successional forests even when fires occur frequently. There are probably fewer large snags on aspects prone to frequent, high intensity fires.

- Coarse woody debris; The processes that create snags also create coarse woody debris. The amount that exists may depend on the frequency and intensity of fire.

- Species diversity; Countless species exist in late seral forests, many of which are difficult to inventory and describe. Large conifers including Douglas-fir, grand fir, incense-cedar, western red cedar and western hemlock are present in the oldest stands. Hardwoods and shrubs are common. The late seral stage includes areas of early and mid seral development interspersed.

Arrangement of Stand Structures

As previously described the arrangement of natural stands is dependent on process, and results in a mosaic of single and multi-cohort stands across the landscape. Currently natural stands are interspersed with younger, managed plantations.

The map of the current age class distribution shows the arrangement of the stands and seral stages. Stands 80+ years and older are classified as late successional (for this report), stands 20 years and less are classified as early seral, and stands 21 to 79 years are classified as mid seral.

There are also some interesting maps that show the arrangement of stands in the past. One is the 1914 forest type map that shows large areas that were burned and restocking or not restocking, and merchantable timber. Most of the old fire areas shown on this map are discernable today. We can assume that the merchantable timber would be classified as old growth today.

Description of Current Conditions

Table IV-1 shows the existing age class distribution on federal land within the RWC. Refer to Table IV-1 and Figure IV-1, as it pertains to the following discussion.

Early Seral

Approximately 13 percent (2157 ac) of the federal lands are less than 21 years of age and can described as being in an early seral stage of development. These are Douglas-fir plantations established after logging with anywhere from about 400 to 600 seedlings per acre. Nearly all of these plantations received seed fall from adjacent stands which increased the stems per acre considerably.

All of the stands surveyed that are from 16 to 20 years of age that have not been precommercially thinned (PCT'd) are overly dense. There is intense competition between trees in these overly dense stands that often result in diameter growth at less than half of potential, reduction in live crowns, and tree mortality. Competition induced mortality, snow break, blowdown, and disease pockets naturally open these stands allowing for differentiation. These natural processes may in time create healthy, diverse stands. However, these densities are probably higher than what normally occurs in nature, and the increase in stress factors may increase the risk of damage from insect, disease , and possibly fire. Full crowned trees, large snags, and coarse woody debris are currently scarce in these stands, and will probably take a long time to develop. Precommercial thinning these stands may allow us the opportunity to accelerate the development of large trees of various forms and species, reduce the risks associated with overly dense conditions, and promote late successional characteristics.

Table IV-1. Existing age class distribution on federal lands within the Rader-Wolf-Cougar WAU.

Age Class	Total Acres	PCT'd[1] Acres	Fert Acres	CT'd[2] Acres	Natural Regen	Seed or Planted
0-15	1046	5			3	1043
16-20	1111	111				1111
21-30	1637	383			96	1541
31-40	563	209	176	42	62	501
41-60	358				358	
61-79	1457			249	1457	
80+	10610	29[*]				
Totals	16,782.00	737	176	291	1976	4196

[1] Precommercailly thinned.
[2] Commercially thinned.
[*] 29 acres of understory natural regeneration precommercially thinned.

Mid Seral

There are 4015 acres that can be described as mid seral, 21-79 years old. This is about 24 percent of the landscape. It includes plantations and natural stands that originated after fire.

There are 1,637 acres 21 to 30 years of age. Ninety-six (96) acres originated from natural regeneration and 1541 acres are plantations. All of these stands were intensively managed for timber production at densities that would provide for first commercial entry at about age 35 to 40. In the mid 1980s PCT was not funded, and many acres were left overly dense. Only 383 acres have been PCT'd to date. All of the stands surveyed, including many of the stands that have been PCT'd, are currently overly dense. Some regulation of density, whether commercial or not, would probably accelerate attainment of LSR objectives.

There are 563 acres 31 to 40 years of age. Five hundred and one (501) acres were planted and the remainder was naturally regenerated. 209 acres have been PCT'd, and 176 PCT'd acres were subsequently fertilized. Management for timber production has resulted in uniform stands of Douglas-fir at densities that would provide the first commercial thinning opportunity at about age 40. 42 acres of commercial thinning have been accomplished. Density management would give us the opportunity to improve conditions for development and enhancement of late successional characteristics, and may facilitate the protection of the reserve from catastrophic fire by allowing for fuels treatment and road maintenance.

There are 1,815 acres of natural stands 41 to 79 years of age. All of these stands originated after stand replacing fires. Some of these stands contain old growth characteristics including large old remnant trees, large snags, and coarse woody debris. Natural canopy openings have allowed a shrub layer to persist. Hardwoods and conifer regeneration are also common in some of these stands. Although these stands are best described as mid seral, they are functioning much like old growth.

Two hundred and forty-nine (249) acres of stands age 41 to 79 have been commercially thinned. Twenty-two acres of the commercial thinning was done when stands were 60 years of age, and the remainder was done when stands were 50 years of age. One of the areas commercially thinned is planned for a second thinning as part of a formal research project. The project will study the effectiveness of density management to accelerate the development of late successional characteristics.

<u>Late-Successional</u>

Approximately 63 percent (10,610 acres) of the federal lands are currently 80 or more years of age and can be classified as late successional forests. This type is somewhat continuous in the WAU where federal sections adjoin one another.

These old, natural stands are composed of predominately Douglas-fir in association with other conifers; including grand fir, incense-cedar, western red cedar, western hemlock and Pacific yew. The oldest and largest trees often contain rot, have dead and broken tops, and have survived numerous past fires. Large snags and coarse woody debris are common features in these forests. Multiple canopy layers exist where understory trees develop in openings. Where recent stand replacing fires have occurred, this type is often found along the stream bottoms, and occasionally scattered in the upland areas in a random pattern, and as a minor component in younger single cohort stands.

Ring analysis on stumps and increment cores from live trees within natural single cohort stands that are interspersed within the old growth type suggest these trees often spend their entire life growing in close proximity to other trees, and growth rates are slow. These trees exhibit tall, straight stems with few to no persistent dead limbs on the lower portion, and have small live crowns. Rings per inch range from 7 to more than 10. Occasionally these stands are found containing well spaced dominant trees at densities that optimize growth. Growth of One-half inch in diameter and three feet in height per year is not uncommon under these stand conditions.

Open grown trees are less common, but can be found as a minor component in most old stands. These trees exhibit large diameters, large limbs, and large live crowns. Old trees with these characteristics are occasionally found in younger stands that were initiated after stand replacing fires. It is puzzling how these trees survived the fire with live limbs intact; indicative of the capricious nature of fire.

Prevalent understory shrubs include ocean spray, hazel, and vine maple. Manzinita, willow, coyote brush, and ceanothus spp. are also common. Hardwoods include madrone, big leaf maple, red alder, and chinkapin. Sword fern and salal are common on the forest floor.

There are countless other species associated with this type including lichens, mosses, fungi, grasses, and soil micro flora. It is expected that the LSR would contain some of the species described under Protection Buffers and in Table C-3 of the ROD (USDA USDI 1994).

Noxious Weeds

Certain species of plants have the ability to build seed banks in the soil that are persistent and viable for many years. When a disturbance occurs, the seeds rapidly germinate and grow, and the plant dominates the site. This can become a stable and long lasting condition, and trees may be excluded. Scotch broom and gorse are introduced plants that have this adaptation. Scotch broom is currently invading along roads and in recent plantations.

Private Lands

Private lands totaling 13,831 acres are interspersed with federal lands within the WAU. At this time there is a considerable area that contains the late seral type on private lands. It is probable that this type will be harvested in the near future. We can assume that the private lands will be managed for timber production on rotations that maximize present net worth. This will likely result in Douglas-fir plantations that range in age from 0 to about 50 years of age.

A major consequence of these interspersed private lands is the need to suppress fires within the WAU in order to protect this private property. The lack of naturally occurring fires will have an effect on the LSR and may need to be mitigated. Density management prescriptions may help to alleviate the missing component of fire.

Reference Conditions

The reference condition is based on the period of time just prior to forest development for timber production. The analysis and description of the reference condition is based on 1959 aerial photos, existing forest inventory records, surveys of some existing natural stands, and professional judgement.

The 1959 aerial photos are a good reference because they show about 96 percent of the federal lands and 30 percent of the private lands prior to development. We have a nearly complete photo coverage of the WAU showing the spatial arrangement of natural stands, and some structural differences. Many of the stands have been delineated on these photos and are typed showing age of overstory and understory trees. An analysis of stands in relation to elevation and aspect is possible with the photo stereo pairs.

The 1959 photos reflect some change in structure and composition that has occurred due to the roading, harvesting, and fire suppression activities within the developed sections. Intensive development for timber production began in 1943 within the WAU.

A fire history is very evident on the aerial photos. There are numerous small and scattered young natural stands interspersed with the oldest type. A few large, continuous young natural stands are evident throughout the WAU. As would be expected most of these are seen on southerly aspects and along ridge tops. North aspects and stream channels contain some of the oldest and largest trees.

Many stand replacing fires occurred in the early 1900s. One thousand, four hundred and fifty-seven (1,457) acres on federal land exist in stands that originated after fire and established between 1920 and 1930. These were stand replacing fires of up to 220 acres in size that created large single cohort stands of predominately Douglas-fir. The photos indicate remnant old trees are sparsely scattered within many of these stands. Examples of large stand replacing fires with few to no remanent large trees can be found in sections 9 and 24 of Township 25 south and range 8 west.

It is interesting to note that 9,645 acres of the 10,610 acres in stands that are typed greater than 79 years of age either have an understory component that originated in the late 1800's and early 1900's, or the stand was established during this time period. This would suggest that fire activity was extensive around the turn of the century, effecting up to 70 percent of the federal lands. Additional evidence to support this conclusion can be found in the 1914 state forest type map, which shows large areas as burned and restocking.

There are 358 acres of natural stands ranging in size from 3 to 48 acres that were established from 1940 to 1955. 72 acres of this total are typed as natural, no past management. The 1959 and 1994 photos would indicate that

25 acres of this type originated after a seed tree harvest, and the rest regenerated after fire. The stand establishment dates after fire may be inaccurate, as many look older on the photos. Because the establishment date coincides with the beginning of extensive commercial logging it is hard to say whether or not these are natural stands. The age of these stands could be verified in the field using increment bores.

The extent and the recent decline in fire activity may correspond to a change in climatic conditions, or to the beginning of fire suppression activities.

Early Seral

From the analysis of fire activity on federal lands, we can state that prior to forest development approximately 1,500 acres existed in an early seral stage as a result of fire. This is about 9 percent of the total federal forest land within the WAU.

The percent of area in the early seral may have been higher prior to fire suppression activities. In fact, it is possible that these forests burned every year to some degree. Dry lightning is a common occurrence today, and if left unchecked would result in nearly continuous fire activity during the fire season. How many of these fires would become large stand replacing fires is anybody's guess.

Consider the lightning storm of 1987. On August 31st of that year thousands of lightning strikes were recorded throughout Oregon and Northern California. One on these lightning fires occurred on McGee Creek, a drainage that is adjacent to the WAU. A tractor and fire crew contained this fire at less than 3 acres in size. Burning conditions that year were such that many large fires built convection columns and consumed thousands of acres of mature and young forest in spite of suppression attempts. These conditions persisted off and on for two weeks, and rain did not occur until mid December. The effect of this dry lightning storm on an undeveloped natural forest under these conditions may have created many thousands of acres of early seral structures.

Mid Seral and Late Successional

The mid seral and late successional structural type is interspersed in natural stands and functioning as old growth. Attempts to delineate by structural difference and/or classify by age would be tedious and of limited use.

Approximately 91 percent of the federal lands within the WAU were in the mid seral to late successional stage of development in 1959. It is probably safe to say that the land area in this stage of development has varied in time depending on fire activity.

The LSR objectives are to protect and enhance conditions of late successional and old growth forest ecosystems. Silvicultural activities are limited to stands that are less than 80 years of age. The primary thrust of management on these lands is protection and maintenance (ROD RMP 1995).

Noxious weed infestations are to be contained and/or reduced on lands administered by the Bureau of Land Management using an integrated pest management approach. The introduction or spread of noxious weeds into any area is to be avoided (page 29, ROD RMP 1995). This must include control along roads where seeds are picked up and spread by vehicles. Cutting, burning, spraying with herbicides, and release of insects that prey on plant seeds are all possible control mechanisms for Scotch broom.

V. FISHERIES (Stream Channel)

V-1 Introduction

The Bureau of Land Management (BLM) administers approximately 13,000 miles of spawning and rearing streams for anadromous (and resident) salmonids in five States: Alaska, California, Idaho, Oregon and Washington (Table V-1). As stated in various Bureau documents, the BLM has made it a priority to work towards the protection, restoration and enhancement of anadromous and native fish stocks and to restore and maintain their associated watersheds and aquatic ecosystems (USDA and USDI 1994, BLM Fish and Wildlife 2000: A Plan for the Future, ROD RMP 1995, USDA et al. 1995).

Table V-1. Anadromous fish habitat on Bureau lands.

State	Miles of Habitat	Major Species
Alaska	10,000*	Chinook, sockeye, chum and pink salmon, steelhead trout, char, cisco, whitefish
California	190	Chinook, coho, steelhead
Idaho	1,300	Chinook, sockeye, steelhead
Oregon	1,432	Coho, chinook, chum, steelhead, sea-run cutthroat trout
Washington	51	Steelhead, chinook
TOTAL	12,973	

* Actual inventory data for Alaska streams is not available. Estimate of stream miles derived from a variety of sources

V-2 Historical Conditions

Fish have been (and continue to be) an extremely important ecological, commercial and recreational consideration in the State of Oregon and the Umpqua River Basin. Salmon remain a critical component of subsistence fisheries and the cultural heritage of Native American. Since the settlement of the State and the basin by Europeans, anadromous salmonids, especially Coho salmon (Oncorhynchus kisutch), have been the mainstay of the commercial and recreational salmon fishery of the Oregon Coast.

V-2.1 Coho Salmon

Coho salmon occur naturally only in the Pacific Ocean and its tributary drainage. It's range in fresh water in North America is from Monterey Bay, California (in the sea infrequently to Baja California) to Point Hope, Alaska. In Asia, Coho occur from the Anadyr River, Russia to Hokkaido, Japan (Scott and Crossman 1973).

One hundred years ago, runs of wild coho in coastal Oregon streams were estimated at 1,400,000 fish per year. In the 1970s, the coho troll fishery provided from $60 to $70 million per year in direct personal income for Oregon coastal communities. By 1988, the salmon harvest (including chinook) generated $43 million for the Oregon coast economy. In 1993, salmon harvest (coho fishery now closed) generated only $3.5 million - an 85% reduction of economic benefits in six years. The average number of spawners in 1991-1993 was estimated at 38,000 fish, about 3% of the historical level stated above (Oregon Sea Grant, January 1995).

It is estimated that wild coho populations in the Umpqua basin account for 25-30% of the total number of wild coho along the Oregon coast (Loomis, personal communication, as cited in the Jackson Creek Watershed Analysis). Umpqua coho contribute primarily to Oregon ocean fisheries, with a minor contribution to the northern California and the southern Washington ocean harvest.

Wild coho salmon in the Umpqua basin were assessed at a moderate risk of extinction due to widespread habitat degradation and influences from hatchery-reared fish (Nehlsen et al.., 1991). In July 1995, the Umpqua coho, along with four other stocks in Oregon, were officially proposed as Threatened by the National Marine Fisheries Service (NMFS).

V-2.2 Cutthroat Trout

The cutthroat trout (O. *clarki*) occurs in fresh, brackish or salt water in North America mostly west of the Rocky Mountains. Its distribution closely corresponds with the Pacific Northwest and Alaska coniferous rain forests, extending on the coast from the Eel River in northern California to Prince William Sound, southeastern Alaska. Cutthroat trout are also found as far inland as central Colorado and northwestern New Mexico (Scott and Crossman 1973).

Sea-run cutthroat trout (CTT) have also been an important fishery in Oregon since the mid-1930s. Runs sizes varied greatly between river basins, with the Suislaw River having the largest - approximately 31,000 fish. In the North Umpqua River, the average run size was 700 spawners between 1946 and 1960 (Schneider, personal communication). In a report prepared in 1972 by the Oregon State Game Commission (OSGC), it was estimated that 2,000 sea-run CTT spawned in the North Umpqua system.

Recently, the run size in the North Umpqua has declined precipitously. The average run size between 1986-87 and 1994-95 was 28 fish at the Winchester dam, with no fish counted in 1992-93 and only one in 1994-95 (ODFW, 1995). CTT were listed as Endangered by NMFS on July 30, 1995 in the Umpqua River Basin, with all life forms included in the listing.

V-3 Desired Future Condition

To maintain and/or restore properly functioning aquatic ecosystems for anadromous and resident salmonids and other native fish species.

V-4 Key Questions

The Key Questions to be answered in this watershed analysis regarding fish are:

- What species occur and what is their distribution in the analysis area?
- What are the current habitat conditions and what are the identifiable limiting factors to fish production and distribution?
- Where is good quality fish habitat?
- What management actions (and inactions) are needed to maintain and improve good, and improve and restore degraded, habitats?

V-5 Fish Occurrence and Distribution

Key Question: What species occur and what is their distribution in the analysis area?

The Umpqua River Basin is home to seven native anadromous species of fish, including the endangered cutthroat trout and coho salmon; more than ten native resident species; and at least eighteen non-resident/exotic/introduced species (See Table V-2).

Historically, the entire Umpqua River basin stream network either supported, or had the potential to support, anadromous salmonid production. For purposes of this watershed analysis, fish distribution is noted to the most upstream point within each stream, with the assumption that anadromous salmonids are also likely to be found to at least this point, in the absence of passage problems and water quality limitations (Figure V-1).

Table V-2. List of fish in the Umpqua River basin.		
TYPE	COMMON NAME	SCIENTIFIC NAME
NATIVE ANADROMOUS	Sea-run Cutthroat trout Coho salmon Summer/Winter Steelhead trout Spring/Fall Chinook salmon Green Sturgeon White Sturgeon Pacific lamprey	*Oncoryhnchus clarki Oncoryhnchus kisutch* *Oncoryhnchus mykiss* *Oncoryhnchus tshawytscha* *Acipenser medirostris* *Acipenser transmontanus* *Lampetra tridentata*
NATIVE RESIDENT	Cutthroat trout Rainbow trout Oregon (Umpqua) chub Umpqua dace Longnose dace Umpqua squawfish Largescale sucker Redside shiner Speckled dace Brook lamprey Sculpin species	*Oncoryhnchus clarki* *Oncoryhnchus mykiss* *Oregonichthys kalawatseti* *Rhinichthys evermanni* *Rhinichthys cataractae* *Ptychocheilus umpquae* *Catostomus macrocheilus* *Richardsonius balteatus* *Rhinichthys osculus* *Lampetra richardsoni* *Cottus spp.*
NON-NATIVE	Brown trout Brook trout Lake trout Kokanee Largemouth bass Smallmouth bass Sunfishes Yellow perch White Crappie Black Crappie Black Bullhead Brown Bullhead Yellow Bullhead Peamouth Striped Bass Shad Mosquito fish Threespine stickleback Olympic mudminnow	*Salmo trutta* *Salvelinus fontinalis* *Salvelinus namaycush* *Oncorhynchus nerka* *Micropterus salmoides* *Micropterus dolomieu* *Lepomis spp.* *Perca flavescens* *Pomoxis annularis* *Pomoxis nigromaculatus* *Ameiurus melas* *Ameiurus nebulosus* *Ameiurus natalis* *Mylocheilus caurinus* *Morone saxatilis* *Alosa sapidissima* *Gambusia affinis* *Gasterosteus aculeatus* *Novumbra hubbsi*

Sources: BLM Roseburg District PRMP/EIS, Vol. II;
Dave Harris, personal communication, ODFW-Roseburg

V-6 Aquatic Habitat Conditions and Limiting Factors

Key Questions: What are the current aquatic habitat conditions?

Where is the good/properly functioning fish habitat?

What are the identifiable limiting factors to native fish production and distribution?

Anadromous salmonids are an important natural resource of the Umpqua River Basin. The streams in the RWC have historically made significant contributions to salmonid and other native fish production. The RWC, as with most subbasins on BLM Roseburg lands, has a fairly long, continuous disturbance history, with the past forty-five years particularly strong. At present, the majority of the aquatic habitat conditions in the RWC are quite degraded in comparison to natural, properly functioning conditions (Table V-4).

The amount of forested lands in age classes 0-45 years (a measurement of recentness of land disturbance) in the RWC is 14,372 acres, or 47% of all forested lands. Average road density is 4.8 miles/mile^2 (range of 3.9 to 8.8)(Table III-1), with roads along many stream valley bottoms. Timber harvesting and road building continue today. These activities often negatively impact the aquatic ecosystem by causing increases in water temperatures, stream width-to-depth ratios and sedimentation rates; higher base and peak flows; decreases in large woody debris attainment, recruitment and retention; and decreases in channel complexity, side channels and connectivity with the stream floodplains.

<u>Aquatic Habitat Ratings per ODFW Aquatic Habitat Inventories</u> Data from the ODFW Aquatic Habitat Inventories of 1991-1994 were analyzed and aquatic habitat ratings (AHR) of Excellent, Good, Fair or Poor were determined for each reach (Appendix 2-A). Reaches were identified in each stream based on channel and valley morphology, gradient, instream substrate and land use. The ratings were then correlated to the NMFS Matrix (Appendix 2-B), in order to make a determination as to whether the aquatic habitat is properly functioning, at risk or not properly functioning (see Table V-3).

Table V-3 Aquatic habitat ratings.	
ODFW Aquatic Habitat Inventories	NMFS Matrix
Excellent or Good	Properly Functioning
Fair	At Risk
Poor	Not Properly Functioning

In the RWC, ODFW Aquatic Habitat Inventories have been completed, and AHRs determined, for the mainstems of Case Knife, Cougar, Little Wolf, Miner, Rader and Wolf Creeks and select tributaries of Cougar, Little Wolf and Rader Creeks. (Tables V-4 and V-5). No specific AHR was completed for Whiskey Camp Creek. Instead, AHR data for Whiskey Camp Creek was included in Miner Creek, reach 3. The only aquatic habitat rated as Good/Properly Functioning in the entire RWC are two of seven reaches in Cougar Creek and two of four reaches in Cougar Creek Tributary #1.

Stream Habitat Ratings by Benthic Invertebrate Community Composition and Diversity Stream habitat ratings were also determined, based on benthic invertebrate community composition and diversity, for Case Knife, Rader and Wolf Creeks (Table V-6). Rader and Wolf Creeks rated as Low to Severe, with Case Knife Creek rated as Moderate. The ratings indicate these streams have varying degrees of habitat and water quality limitations.

Table V-4: Aquatic habitat ratings for streams in the Rader-Wolf Creek subbasin.

STREAM NAME Survey Dates	Reach No.	Pool Area %	Residual Pool Depth (m)	Wetted W/D Ratio	Riffle Fines %	Riffle Gravels %	Dominant Substrate %	Dominant Canopy	Shade %	LWD Pieces/100m	LWD Vol/100m	Avg. gradient %	Habitat Rating # Class.
CASE KNIFE 19 Aug. 1991	1	15	0.4	15.4	46	51	Gravel ¦ 24	Conifer/Hard	92	8.8	39.2	3.3	52 Fair
LITTLE WOLF 20-27 Aug. 91	1	31	0.5	22.6	25	13	Bedrock ¦ 37	Conifer/Hard	81	4.4	9.0	1.4	43 Poor
	2	26	0.2	-	21	19	Bedrock ¦ 47	Conifer/Hard	61	3.5	10.1	0.8	35 Poor
	3	34	0.5	16.4	36	35	Gravel ¦ 27	Conifer/Hard	81	7.0	19.7	1.4	52 Fair
	4	15	0.3	-	30	28	Gravel ¦ 28	Conifer/Hard	87	4.9	13.5	1.6	35 Poor
LIL WOLF TRIB. #1 28 Aug. 1991	1	22	0.4	24	30	30	Gravel ¦ 25	Conifer/Hard	86	11.4	43.2	2.1	56 Fair
MINER 14-16 Aug. 91	1	14	0.7	20.1	12	27	Bedrock ¦ 31	Conifer/Hard	83	5.6	19.2	1.9	51 Fair
	2	14	0.7	15.7	37	41	Gravel ¦ 27	Conifer/Hard	82	12.8	49.6	2.3	61 Fair
	3	20	0.3	22.0	40	60	Gravel ¦ 31	Conifer/Hard	79	12.4	65.2	1.8	51 Fair

RADER CREEK 20 June - 8 July 1991	1	19	1.0	16.1	15	21	Bedrock ¦ 37	Conifer/Ha rd	94	4.4	12.4	2.1	51 Fair
	2	23	0.4	17.5	26	37	Bedrock ¦ 32	Conifer/Ha rd	94	6.9	20.2	2.2	42 Poor
	3	14	0.3	13.5	14	16	Bedrock ¦ 23	Conifer/Ha rd	87	11.6	31.4	3.7	46 Fair
	4	5	0.5	7.5	29	33	Boulder ¦ 24	Conifer/Ha rd	92	6.8	41.5	5.8	53 Fair

STREAM NAME Survey Dates	Reach No.	Pool Area %	Residual Pool Depth (m)	Wetted W/D Ratio	Riffle Fines %	Riffle Gravels %	Dominant Substrate	Dominant Canopy	Shade %	LWD Pieces /100 m	LWD Vol. /100 m	Avg. gradient %	Habitat Rating # Calss.
RADER TRIB. #1 31 July 1991	1	16	0.4	-	18	26	Bedrock ??	Conifer/Ha rd	89	11.1	41.1	4.0	48 Fair
RADER TRIB. #2 29 July 1991	1	12	0.3	15.5	50	35	Silt/Org ¦ 36	Conifer/Ha rd	93	18.9	62.2	7.3	53 Fair
RADER TRIB. #3	1	9	0.5	17.2	30	33	Bedrock ¦ 21	Conifer/Ha rd	93	6.0	23.3	2.0	50 Fair
(Winterboth am Creek)	2	34	·0.4	-	13	22	Silt/Org ¦ 32	Conifer/Ha rd	84	16.4	40.3	2.0	54 Fair
15-18 July 91	3	50	0.7	16.2	41	34	Silt/Org ¦ 41	Conifer/Ha rd	81	6.0	19.8	2.8	58 Fair
RADER TRIB. #3A 26 July 1991	1	7	0.3	16.0	30	40	Silt/Org ¦ 25	Conifer/Ha rd	96	11.1	44.1	4.8	53 Fair
RADER TRIB. #3B 23 July 1991	1	14	0.5	-	5	30	Bedrock ¦ 30	Perennial Mix	89	1.9	4.7	12.0	46 Fair
RADER TRIB. #4 11 July 1991	1	3	0.4	-	29	30	Gravel ¦ 23	Conifer/Ha rd	96	10.1	51.7	7.0	48 Fair

RADER TRIB. #5 9 July 1991	1	2	0.4	-	29	34	Boulder ¦ 37	Conifer/Hard	89	6.6	20.0	9.3	42 Poor
RADER TRIB. #6 9 July 1991	1	2	0.4	8.0	10	38	Boulder ¦ 31	Conifer/Hard	91	5.7	23.1	12.6	55 Fair
WHISKEY CAMP CK.			Included in Reach 3 of Miner Creek										
WOLF CREEK	1	15	1.4	25.1	14	18	Bedrock ¦ 49	Hardwoods	76	0.7	2.1	0.9	48 Fair
5-13 Aug. 1991	2	13	1.3	27.5	18	30	Bedrock ¦ 36	Conifer/Hard	70	1.8	3.4	0.9	47 Fair
	3	7	0.9	38.0	18	24	Bedrock ¦ 39	Conifer/Hard	82	1.7	3.8	0.8	39 Poor
	4	8	0.3	12.2	27	35	Gravel ¦ 25	Conifer/Hard	77	8.8	23.4	1.7	41 Poor
	5	23	0.4	19.1	32	47	Gravel ¦ 28	Conifer/Hard	79	15.3	36.2	2.5	56 Fair
	6	2	0.3	–	26	26	Silt/Org ¦ 30	Conifer/Hard	79	12.1	60.4	2.5	43 Poor
Conditions Key	excell good fair poor	> 44 30-44 16-29 < 16	> 0.59 0.41-0.59 0.21-0.40 < 0.21	< 11 11-20 21-29 > 29	< 2 2-7 8-14 > 14	> 79 30-79 16-29 < 16	Gravel/Cobble Cobble/LgBldr Cobble/SmBldr Bedrock/anythg	Conifers/hdwd Conifers/hdwd hdwd/conifers alder/anything	> 79 71-79 61-70 < 61	> 29 20-29 11-19 < 11	> 39 30-39 21-29 < 21		> 82 63-81 44-62 < 44

Table V-5: Aquatic habitat ratings for streams in the Cougar Creek subbasin

STREAM NAME Survey Dates	Reach No.	Pool Area %	Residual Pool Depth (m)	Wetted W/D Ratio	Riffle Fines %	Riffle Gravels %	Dominant Substrate %	Dominant Canopy	Shade %	LWD Pieces /100 m	LWD Vol /100 m	Avg. gradient %	Habitat Rating # Class.
COUGAR 6-15 Sept. 1994	1	47	0.4	30.8	7.0	50.0	Bedrock ¦ 47	Hardwoods	86	15.3	41.8	1.3	61 Fair
	2	66	0.4	15.0	95.0	5.0	Bedrock ¦ 35	Hardwoods	71	17.7	36.9	1.6	54 Fair
	3	37	0.3	23.8	40.0	34.0	Gravel ¦ 36	Conifer	91	25.9	83.8	2.1	57 Fair
	4	10	0.3	10.0	0.0	40.0	Gravel ¦ 46	Conifer	82	43.2	62.6	5.9	68 Good
	5	4	0.4	-	10.0	43.0	Gravel ¦ 29	Hardwoods	96	11.4	19.2	10.2	47 Fair
	6	91	0.9	-	50.0	40.0	Silt/Org ¦ 61	Hardwoods	43	73.1	58.4	5.4	64 Good
	7	0.0	0.0	-	23.0	37.0	Gravel ¦ 32	Conifer	97	9.1	11.4	18.2	34 Poor
COUGAR TRIB. #1	1	69	0.4	11.8	45.0	23.0	Sand ¦ 34	Hardwoods	55	33.5	64.8	1.7	63 Good
10-11 Oct. 1994	2	41	0.5	-	5.0	52.0	Bedrock ¦ 35	Conifer	88	12.1	27.4	1.7	55 Fair
	3	37	0.3	9.0	5.0	60.0	Gravel ¦ 43	Hardwoods	87	28.9	59.9	2.1	67 Good
	4	12	0.3	-	5.0	51.0	Gravel ¦ 36	Conifer	94	10.9	21.2	6.2	47 Fair

Conditions Key	**excell good fair poor**	> 44 30-44 16-29 < 16	> 0.59 0.41-0.59 0.21-0.40 < 0.21	< 11 11-20 21-29 > 29	< 2 2-7 8-14 > 14	> 79 30-79 16-29 < 16	**Gravel/Cobble Cobble/LgBldr Cobble/SmBldr Bedrock/anythg**	**Conifers/hdwd Conifers/hdwd hdwd/conifers alder/anything**	> 79 71-79 61-70 < 61	> 29 20-29 11-19 < 11	> 39 30-39 21-29 < 21	< 56 56-60 61-69 > 69	> 82 63-81 44-62 < 44

Table v-6: Stream habitat rating by benthic invertebrate community composition and diversity.

	EROSIONAL HABITAT		MARGIN HABITAT		DETRITUS (CPOM)	
STREAM - Date of Sampling	TOTAL SCORE (% of Maximum Possible Score)	Habitat Rating	TOTAL SCORE (% of Maximum Possible Score)	Habitat Rating	TOTAL SCORE (% of Maximum Possible Score)	Habitat Rating
Case Knife Creek - Oct. 1992	55.6	Low	72.4	Moderate	72.9	Moderate
Rader Creek - Oct. 1992	41.9	Low	45.9	Severe	53.1	Low
Lower Wolf Creek - Oct. 1992	37.1	Severe	43.9	Severe	29.2	Severe
Lower Wolf Creek - Oct. 1991	37.9	Severe	41.8	Severe	42.7	Severe
Lower Wolf Creek - Sept. 1990	47.6	Low	--	??	--	??
Mid-Wolf Creek - Oct. 1992	38.7	Severe	60.2	Low	53.1	Low
Mid-Wolf Creek - Oct. 1991	34.7	Severe	48.0	Severe	58.3	Low
Mid-Wolf Creek - Sept. 1990	36.3	Severe	--	??	--	??
Upper Wolf Creek - Oct. 1992	52.4	Low	62.2	Low	64.6	Low
Upper Wolf Creek - Oct. 1991	42.7	Low	56.1	Low	47.9	Severe
Upper Wolf Creek - Sept. 1990	30.6	Severe	--	??	--	??

Rating Scale: Erosional	Margin & Detritus	
90-100%	**90-100%**	**Very High**
80-89%	**80-89%**	**High**. High in habitat complexity, biotic integrity, taxa richness, % of cool water adapted fauna, number of more specific microhabitat related taxa, etc.; Low in numbers of highly tolerant taxa.
60-79%	**70-79%**	**Moderate**. Moderate as above. The benthic invertebrate community points to some habitat limitations
40-59%	**50-69%**	**Low**. Low as above. The community reflects significant habitat and/or water quality limitations.
<40%	**<50%**	**Severe**. The community present has developed under habitat conditions that represent a severe departure from the ideal conditions.

2.6.1 Rader-Wolf Subbasin

The Rader-Wolf subbasin is 60% federal and 40% private ownership. The main land use activity is timber harvesting. There are 243.3 miles of streams with a drainage (stream) density of 4.7 miles/mile^2. The road density is 4.8 miles/mile^2, with roads along many stream valley bottoms. All streams rate as either Fair/At Risk or Poor/Not Properly Functioning.

The dominate channel substrate in the subbasin is bedrock. From 1990 to 1992, BLM workers and volunteers from the Salmon and Trout Enhancement Program (STEP) built and/or placed approximately 200 structures (logs, rootwads, boulders and dynamite-created pools) in Wolf, Rader, Miner and Little Wolf Creeks in an attempt to aggrade the stream channels and create some habitat diversity. After five years, the results of these efforts are inconclusive. There is a great lack of large woody debris (LWD) in most streams and many of the streams are constricted to narrow channels (mostly as a result of adjacent roads), thus there are few mechanisms and opportunities for the streams to meander and to form side channels and backwater areas (alcoves).

Case Knife Creek: There is one delineated reach in this stream, with as AHR of **Fair/At Risk**. The Case Knife compartment has 9.1 stream miles, with a drainage density of 4.3 miles/mile^2. Road density is 4.5 miles/mile^2, with only a small amount of road along the stream valley bottom. Ownership is 64% federal and 36% private.

Limiting factors include: low probablity of LWD attainment and recruitment, low amount of pool areas and a high percentage of fine sediment in riffles.

Little Wolf Creek: There are four reaches delineated in this stream; three with AHRs of **Poor/Not Properly Functioning** and one which rates as **Fair/At Risk**. The Little Wolf compartment has 26.6 stream miles, with a drainage density of 4.8 miles/mile^2. Road density is 4.3 miles/mile^2, with a road along much of the stream valley bottom; BLM road 25-8-1.1. Ownership is 71% federal and 29% private.

Limiting factors include: low probablity of LWD attainment and recruitment, shallow residual pool depths, high percentage of bedrock substrate and a high percentage of fine sediment in riffles.

Little Wolf Creek Tributary #1: There is one reach delineated in this stream with an AHR of **Fair/At Risk.** The Lower Little Wolf compartment has 13.2 stream miles, with a drainage density of 4.9

miles/mile^2. Road density is 3.9 miles/mile^2, with only a small amount of road along the stream valley bottom. Ownership is 49% federal and 51% private.

Limiting factors include: low amount of LWD and low likelihood of near-future attainment and recruitment, low amount of pool areas and a high percentage of fine sediment in riffles.

Miner and Whiskey Camp Creeks: There are three reaches delineated in this stream with AHRs of **Fair/At Risk**. Habitat conditions in Whiskey Camp Creek are assumed to be comparable to reach 3 of Miner Creek, and thus also rates as **Fair/At Risk**. The Miner and Whiskey Creek compartments have 27.4 stream miles, with a drainage density of 4.7 miles/mile^2. Road density is 5.9 miles/mile^2 (8.8 miles/mile^2 in the Miner Creek compartment!), with roads along much of the stream valley bottoms; mainly BLM roads 26.4 and 27.0. Ownership is 75% federal and 25% private.

Limiting factors include: lack of LWD and its near-future natural attainment and recruitment, low amount of pool areas, high percentage of bedrock substrate and a high percentage of fine sediment in riffles.

Rader Creek: There are four reaches delineated within this stream; three with AHRs of **Fair/At Risk**, and one which rates as **Poor/Not Properly Functioning**. Included in the Rader Creek compartment are Rader Tributaries Nos. 2, 3, 3A, 3B, 4, 5 and 6. All have AHRs of **Fair/At Risk**, except No. 5, which rates as **Poor/Not Properly Functioning**. The Rader Creek compartment has 44.1 stream miles, with a drainage density of 5.1 miles/mile^2. Road density is also 5.1 miles/mile^2, with a highly-utilized, mostly-paved road along nearly the entire stream valley bottoms, BLM 25-7-5.1 and 24-7-10.0. Ownership is 58% federal and 42% private.

Limiting factors include a lack of LWD and its near-future natural attainment and recruitment, low percentage of pool areas, very high percentage of channel substrate dominated by either bedrock or silt/organics, and low percentage of gravel in riffles.

Rader Creek Tributary #1: This stream is sometimes referred to as Picnic Creek. The AHR for the one delineated reach is **Fair/At Risk**. The Upper Wolf compartment has 17.6 stream miles, with a drainage density of 4.6 miles/mile^2. Road density is 7.0 miles/mile^2, with a road along part of the stream valley bottom, BLM 24-7-23.2 and along one of the tributaries, BLM 24.0. Ownership is 57%

federal and 43% private.

Limiting factors include a lack of LWD and its near-future natural attainment and recruitment, low percentage of pool areas, high percentage of channel substrate dominated by either bedrock or sand/silt/organic material, high amount of fine sediment and low percentage of gravel in riffles.

Wolf Creek: There are six reaches delineated within this stream; three which have AHRs of **Fair/At Risk** and three which rate as **Poor/Not Properly Functioning.** In the Middle and Lower Wolf compartments there are 34.9 stream miles, with a drainage density of 4.3 miles/mile^2. Road density is approximately 5.4 miles/mile^2, with highly-utilized roads along much of the stream valley bottom, BLM 25-7-5.1 and 24-7-23.3. Ownership is 54% federal and 46% private.

Limiting factors include a lack of LWD and its near-future natural attainment and recruitment, low percentage of pool areas, very high percentage of channel substrate dominated by either bedrock or silt/organic material, and low percentage of gravel in riffles.

2.6.2 Cougar Creek Subbasin

The Cougar Creek subbasin is 39% federal and 61% private ownership. The main activity is timber harvesting. There are 69.4 miles of streams with a drainage density of 5.9 miles/mile^2. Road density is 4.5 miles/mile^2, with very few roads along stream valley bottoms.

The subbasin has had very recent timber harvest activities. There are elevated amounts of sand, silt and sediment in the streams, especially near the confluence of Cougar Creek and Cougar Creek Tributary #1.

Cougar Creek: There are seven delineated reaches, four with AHRs of **Fair/At Risk,** two rated as **Good/Properly Functioning** and one rated as **Poor/Not Properly Functioning.** The Cougar Creek and Extra Cougar compartments have 42.3 miles of streams with a drainage density of 5.4 miles/mile^2. Road density is 4.4 miles/mile^2 with only one road along a portion of the stream valley bottom, BLM 25-7-21.0. Ownership is 50% federal and 50% private.

Limiting factors include a lack of LWD and its near-future natural attainment and recruitment, two reaches with low percentage of pool areas, very high percentage of channel substrate dominated by either bedrock or silt/organic material, and high percentage of fine sediments in riffles (three reaches over 40%, with one at 95%!).

Cougar Tributary #1: There are four delineated reaches, two with AHRs of **Fair/At Risk** and two rated as **Good/Properly Functioning** The Upper Cougar compartment has 27.1 miles of streams with a drainage density of 6.9 miles/mile^2. Road density is 4.6 miles/mile^2, with only one road along a portion of the stream valley bottom, BLM 25-8-15.2. Ownership is 2% federal and 98% private.

Limiting factors include ownership pattern, a low amount of LWD in reaches 2 and 4, a high percentage of fine sediment and sand in reach 1, and a high percentage of bedrock substrate in reach 2.

VI. WATER QUALITY

Standards by Law and Beneficial Uses

The Clean Water Act of 1977 (Bureau of National Affairs, 1977, Sec 101 a.) states: the objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the nations' waters. The act directs the State to set water quality standards that are not to be exceeded. Water quality will be managed to protect and recognize beneficial uses.

The Oregon Administrative Rules Antidegradation Policy (OAR 340-41-026) intent is to maintain water quality of the state (Department of Environmental Quality (DEQ), 1994). The general policy for surface waters is to guide decisions that affect water quality such that unnecessary degradation from point and nonpoint sources of pollution is prevented, and to protect, maintain, and enhance existing surface water quality to protect all existing beneficial uses. The Standards for this policy for the Umpqua Basin is set forth in Oregon Administrative Rules (OAR 340-41-282). OAR 340-41-282 sets forth specific water quality standard which are not to be exceeded, designed to protect designated beneficial uses.

OAR 340-41-282; Table 3, identifies Beneficial Uses for the Umpqua Basin. *For All Other Tributaries to Umpqua, North & South Umpqua Rivers* the following are considered beneficial uses:

*Public Domestic Water Supply	*Private Domestic Water Supply
*Industrial Water Supply	*Irrigation
*Livestock Watering	*Anadromous Fish Passage
*Salmonid Fish Rearing	*Salmonid Fish Spawning
*Resident Fish & Aquatic Life	*Wildlife & Hunting
*Fishing	*Boating
*Water Contact Recreation	*Aesthetic Quality
*Hydro Power	

Current and Historic Conditions

The DEQ routinely monitors 3,500 mi of streams. Table VI-1 summarizes the DEQ (1988) assessment of nonpoint source pollution related to stream water quality conditions for certain beneficial uses and probable causes. Dates and frequencies for these data are not available; therefore, the time of the year and the magnitude of the problem is not known. These data are the only historic data available except for temperature. The problems associated with the Umpqua River probably are not related to the RWC, but they should be considered indications of possible future water quality conditions.

Table VI-1. Summary of DEQ 1988 NPS assessment.					
Stream (DEQ ID)	Pollution Type	Severity, Data Type[1]	Impacted Beneficial Use	Probable Cause	
				Alteration	Disturbance
Umpqua River (14)	Low DO	Moderate, Observation	Cold Water Fish Other Aquatic Life	Flow Alteration/ Modification	Riparian Vegetation & Bank Disturbance
	Low Flow	Moderate, Observation			
Wolf Creek (30)	Turbidity	Moderate, Observation	Cold Water Fish Other Aquatic Life	Altered Physical Characteristics of Stream	
	Nutrients	Moderate, Observation			
	Sedimentation	Moderate, Data			
	Streambank Erosion	Moderate, Observation			
	Insufficient Stream Structure	Moderate, Observation			

[1] Data type = Observations: The act of visually observing a stream or water quality problem but without specific datat being collect to prove the effect on beneficial uses of the water. Data: Quantifiable information is available to document water quality problems.

For the current study, water samples were collected to identify the general water quality of winter baseflow. The data are in Table VI-2, none were found to exceeding EPA drinking water standards. They generally show the winter baseflow for the RWC is of very good quality for the sampled constituents. The water from these streams show little variation in their chemical characteristics. The water type is a sodium bicarbonate.

Table VI-2. Water quality data collected for select sites in the Rader-Wolf-Cougar WAU.																										
Creek	Location	Date	Q ft^3/s	EC µS/cm	pH	Alkalinity mg/L	Temperature °C	Barometric pressure mm	DO mg/L	Turbidity NTU	N-NO_2 mg/L	N-NO_3 mg/L	F mg/L	Cl mg/L	Br mg/L	P-PO_4 mg/L	SO_4 mg/L	Li mg/L	Na mg/L	N-NH_3 mg/L	K mg/L	Mg mg/L	Ca mg/L	Sr mg/L	Ba mg/L
Little Wolf	T25S/R8 W-11	2/22/96	36.1	58	7.4	13	8.0	765	11.8	3	<.01	<.02	0.2	2.8	<0.2	0.2	3.6	<0.1	3.69	<0.1	0.7	0.16	0.6	<0.3	<0.3
Lower Little Wolf	T25S/R8 W-11	2/26/96	22.6	37	7.3	11	7.0	765	11.2	4	<.01	.05	0.2	2.9	0.3	0.2	2.5	<0.1	3.71	<0.1	0.72	0.16	0.6	<0.3	<0.3
Case Knife	T24S/R8 W-27	2/26/96	24.2	47	7.2	16	7.0	764	11.6	3	.01	.07	0.2	2.9	<0.2	0.2	3.8	<0.1	3.62	<0.1	0.75	0.17	0.6	<0.3	<0.3
Miner	T24S/R8 W-27	2/26/96	38.2	46	7.3	15	7.5	764	11.8	5	<.01	<.02	0.2	3.1	0.2	<0.3	4.2	<0.1	3.83	<0.1	0.88	0.17	0.4	<0.3	<0.3
Wolf	T24S/R8 W-23	2/27/96	23.0	42	7.6	16	7.0	763	11.6	6	<.01	<.02	0.3	3.1	<0.2	0.2	3.5	<0.1	3.65	<0.1	0.76	0.15	0.4	<0.3	<0.3
Rader	T24S/R8 W-23	2/27/96	57.4	42	7.3	15	7.0	763	12.1	4	<.01	.07	0.2	3.0	0.2	<0.3	2.9	<0.1	3.58	<0.1	0.82	0.12	0.4	<0.3	<0.3
Upper Wolf	T24S/R8 W-23	2/27/96	25.7	40	7.4	13	7.0	763	12.1	8	<.01	.17	0.2	2.8	0.2	0.3	2.1	<0.1	3.55	<0.1	0.85	0.14	0.3	0.4	<0.3
Cougar	T24S/R8 W-27	2/27/96	52.9	51	7.7	16	7.0	764	12.0	5	<.01	.03	0.3	3.0	<0.2	<0.3	5.3	<0.1	3.84	<0.1	0.72	0.18	0.6	<0.3	<0.3

The State of Oregon's water quality standard for temperature is being revised upward, currently in streams with salmonids water temperatures must be maintained at or below 58 °F. In non-salmonid streams, no increase above 64 °F is allowed. The BLM monitors stream temperatures at six location in Rader-Wolf. These data have not been summarized by the time this analysis was complete; however, the new listing of water quality limited water bodies by DEQ will include Radar, Miner, and Wolf Creeks. In addition, data exist that were collected by the BLM on Wolf Creek in the 1970's, these data have not been analyzed. Stream temperatures are not monitored in the Cougar Creek watershed and no other long term data have been collected. In general, we see peak temperatures in July when streamflow decreases and the maximum temperature to decrease with distance from the Umpqua River.

The width and height of riparian vegetation on either side needed to provide effective shade varies depending on the width of the stream, the direction of flow (orientation to the sun), and the steepness of the streambanks. Many studies have investigated the effects of riparian vegetation on stream temperatures in the forest of the Pacific Northwest. Holaday (1992) found a trend of decreasing temperature with recovering riparian vegetation which had been removed by flooding, debris flows, or timber harvest. Stream channel characteristics can effect stream temperatures. Streams with narrow channels tend to have cooler stream temperatures. A stream with a gentle gradient is typically wide with shallow flow and slow velocity all of which contribute to stream heating. The diurnal fluctuation in temperature from day to night is important to aquatic organisms and overall water quality. Stress in fish and other organisms is reduced during night time recovery of cooler water. The loss of riparian shade increases the diurnal (day to night) water temperature fluctuation. In a managed basin such as Steamboat Creek, a tributary of the North Umpqua River, diurnal fluctuation has averaged from 7 to 11 °F, while in the unmanaged Boulder Creek wilderness, it has averaged 4 °F (Holaday 1992). The land management activities that have occurred in the RWC, more specifically, the timber harvests have probably been the major contributor to the high stream temperatures currently found within the watersheds.

The equilibrium concentration of dissolved oxygen (DO) in water in contact with air is a function of temperature and pressure. The higher forms of aquatic life require oxygen for survival. According to Hem (1985) the DO concentration may be depleted by processes that consume dissolved, suspended, or precipitated organic matter, and values above equilibrium can be produced in systems containing actively photosynthesizing biota. The eight DO (Table VI-2) samples collected in the RWC were found to be normal.

Streams carry suspended particles or sediment. Particle size depends on the amount of flow. According to Hem (1985) a generalized terminology call sediment having particle diameters ranging from 0.24 to 4 *u*m "clay", 4 to 62 *u*m "silt", and 62 *u*m to 2.0 mm "sand". In general, suspended sediment may be considered a pollutant when it exceeds natural concentrations by increasing the turbidity to a point that it affects the biotic balance. Roads also have the potential to affect the sediment regime. Sediment data have not been collected in this WAU.

Turbidity reduces the depth to which sunlight penetrates and thus alters the rate of photosynthesis and can impair the capture of food by fish. Turbidity is an expression of the optical property of water that scatters light (Dunne and Leopold, 1978). The scattering increases with suspended particulate matter, which may be organic or inorganic. Turbidity increases with, but not as fast as, suspend-sediment concentrations. The DEQ has set forth in Oregon Administrative rules, Chapter 340-41-282 water quality standards for the Umpqua River Basin. The water quality characteristics that are managed to protect recognized beneficial uses include turbidity. The standards set forth that no more than a ten percent increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. These turbidity data have not been collected for the WAU; however, one sample of winter baseflow turbidity were collected. These data (Table VI-2) show the winter baseflow were low in turbidity.

The EPA (1990) report indicated that high turbidity levels can impact salmonids feeding and growth of salmonids and other fish species. Levels of the range of 25-70 nephelometric turbidity units (NTU, measured by photoelectric turbidimeter) impairs the ability of salmonids to find and capture food. Also, growth is reduced and gill tissue is damaged after 5-10 days of exposure to turbidities of 25 NTU. The EPA report also indicated that turbidity can impact drinking water, recreational and aesthetic uses of water.

The DEQ has set forth in Oregon Administrative rules, Chapter 340-41-282 water quality standards for the Umpqua River Basin. The pH standard for aquatic life in the Umpqua Basin is 6.5 to 8.5, set by DEQ. The water quality characteristics that are managed to protect recognized beneficial uses include water pH. Levels above or below have adverse effects on some life cycle stages of certain fish and aquatic macroinvertebrates. MacDonald (1990) report indicated that pH levels of greater than 9 and less than 6.5 can have an adverse affect on fish and aquatic insects. However, sub-lethal affects of higher pH levels on fish are not known.

The Little River Watershed Analysis (BLM and USFS 1995) pointed out that accumulation of algae in streams could affect pH. The process of photosynthesis consumes H+ ions during the daylight hours, elevating pH (more alkaline) and at night pH decreases. Shaded stream reaches and on cloudy days not as much photosynthesis occurs and pH levels are lower. In river waters not influenced by pollution, the process of photosynthesis by aquatic organisms take up dissolve CO_2 during daylight and release CO_2 at night by respiration, fluctuation of pH may occur with the maximum pH values reaching as high as 9.0 (Hem, 1985).

The Little River Watershed Analysis identified conditions that could promote algae growth and accumulations were 1) lack of riparian shade can increase productivity of algae, 2) the presence of bedrock creates habitat for algae, but poor habitat for algae eating insects, and 3) nutrient availability (increase). The Analysis also identified conditions that could promote lower pH included 1) riparian shade 2) gravel/cobble substrate and large wood in streams, which provide habitat for algae eating insects, 3) forest stands upslope which cycle and store nitrogen in vegetation and soil so that it is not available to for runoff.

All pH data collected for these analyses (Table VI-2) were within the acceptable range. No known historical data are available for the WAU.

Toxic substances are another water quality characteristics DEQ requires to be managed to protect recognized beneficial uses. The criteria designates that toxic substances shall not be introduced above natural background levels in water of the state in amounts, concentrations or combinations which may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare; aquatic life, wildlife; per other designated beneficial uses. The criteria for toxic substances shall not exceed the criteria based on the Quality Criteria for Water (EPA 1986) for the various elements. Toxic substances are not suspected to be a water quality concern for the RWC. They were not sampled for and no historical data have been collected.

Robison and Collins (1977) describe the ground water in the Drain-Yoncalla area as diverse in chemical character. There is no definite pattern in chemical character. There is no definite pattern of distribution of the types of water but waters with a high concentration of dissolved solids are more likely to be found near the contacts of the basalt members and the sandstone and siltstone member of the Umpqua Formation. The Tyee Formation is not characterized by a single type of water, except that high concentrations of dissolved solids are not common. The average water temperature reported by drillers was 54 °F almost the same as the mean annual air temperature at Drain (53 °F).

Geology shapes the drainage patterns, determines the type of sediment available to the streams, and influences water chemistry. Soils are a product of weathered bedrock. The type of soils present influence water infiltration rates, erosion potential, and vegetation. Vegetation affects channel stability and upslope erosion rates. Vegetation can also affect stream morphology by providing root strength to stabilize stream banks and by providing organic debris to the streams. Organic debris includes leaf litter, which is an important component of the food chain, and large woody debris, which form pools and capture gravel.

VII. SPECIES AND HABITATS

Affected Environment from a Wildlife Perspective:

The federal forest stands in the combined drainage have the following seral stage distribution (Figure VII-1):

Age	# O.I.Patches	Acres	Percent	Association
0-5	22	398	2.3	grass/forb
6-14	32	622	3.6	shrub
15-24	71	2,159	12.5	open sapling/pole
25-74	70	2,254	13.1	small sawtimber
75-114	33	1,984	11.5	large sawtimber
115-194	19	827	4.8	young old-growth
195+	47	8,978	52.1	old-growth.

The Rader-Wolf/Cougar Creek drainage has 10,989 acres of suitable marbled murrelet and spotted owl habitat within the drainage, and 5,982 acres of land capable of becoming suitable habitat in the future (figure VII-2). The drainage has one known bald eagle nest site and 493 acres of potential nesting habitat. The potential red-tree vole nesting and foraging habitat is estimate to be 9,929 acres, based on a 100+ year old criteria (Figure VII-3).

Some of wildlife species identified in the Northwest forest plan (USDA and USDI 1994) in Table C-3 (S & M species) may be present in future proposed project areas.

Within RWC drainage there are seventy-two ecologically distinct patches of older age habitat (i.e. equal to or greater than 75 years of age), with the following patch size distribution:

Patch Size (acres)	Number of Patches	Average acreage
5-26	24	14.1
27-64	25	39.6
65-100	3	76.3
101-250	13	148.8
251-600	5	378.6
601+	2	3,179.5

Potential Wildlife Species of general interest, identified during the scoping process:

Sensitive Species:	Other Species of Concern:
Northern Spotted Owl	Elk and Deer (big game)
Marbled Murrelet	P. Fringe-tailed Bat
Bald Eagle	Clouded Salamander
Peregrine Falcon	Red-legged Frog
White-footed Vole	Northern Goshawk
Townsend Big-eared Bat	Pileated Woodpecker
Red-tree Vole	N. Saw-whet Owl
	Osprey
	Neotropical Passerines

(See ODFW's "Sensitive Vertebrates of Oregon" (ODFW 1992) for the discussion on the biology of the above species.)

Wildlife concerns/issues considered but eliminated from further analysis due to:
Either they had (1) a low probability of occurring in the drainage; and/or (2) the potential level of impact associated with most ground disturbing projects would be so small as to be immeasureable and therefore unquantifiable and very small (Table VII-1).

Three endangered species (i.e. northern spotted owl, bald eagle, and marbled murrelet)and one topic (big game) were identified in the scoping process and will be analyzed.

Potential Consequences:

Table VII-1. Potential consequences to Special Status Species and a few other species of general interest known to occur within the drainage that may be impacted by ground disturbing activities. (Impact assessment and reasons for impacts are based on the Draft Roseburg EIS, Brown (1985), and ODFW's "Sensitive Vertebrates of Oregon" - 1992.).

Species	Surveyed for	Present	Potential impacts of ground disturbing activities
Spotted Owl	yes	yes	modification of suitable + dispersal habitat
Marbled Murrelet	yes	yes	modification of suitable habitat
Bald Eagle	yes	yes	modification of nesting habitat
White-footed Vole	no	unk	modification of suitable habitat
Townsend's Big-earred Bat	no	unk	not roosting habitat and hibernaculum
Deer	yes	yes	modification of forage and bedding habitat
Elk	yes	yes	modification of forage and bedding habitat
Osprey	yes	no	perching and nesting habitat near river
Neotropical Passerines	yes	yes	modification of nesting and foraging habitat
Red-tree Vole	*	unk	modification of nesting and foraging habitat

* Survey protocol for the red-tree vole is in the process of being developed and will not be available until July or August of 1996.

Wildlife concerns/issues considered:

1. The BLM ownerships in a late-sucessional reserves (i.e. LSRs that were originally designated for the spotted owl and marbled murrelets) and should be managed appropriately, i.e. with actions that are specifically benefical to late-successional species --- like the northern spotted owl and marbled murrelet.

2. Within the drainage there are approximately 11,789 acres of habitat (i.e. foraging and roosting) available for the northern spotted owl. There are sixteen known owl sites within the drainage and they should be managed within the guidelines of the Northwest forest plan (USDA and USDI 1994), and their distribution are as follows:

Site Name	Master Site #	Occupancy/Reproduction: 91	92	93	94	95
Agony Ridge	0368A	P-Y-0	S	P-N	P-Y-2	P-U
Basin Creek	0277	P-N	P-Y-1	P-Y-2	P-N	S
Blue Rader	2208	P-N	P-Y-0	V	V	P-U
Caseknife Creek	0280	P-Y-0	P-Y-2	P-N	P-N	P-N
Cougar Creek	0288A	P-N	S	P-U	P-Y-0	P-N
EF Rader Creek	0507	U	V	V	V	P-Y-0
Little Wolf Trib	0284	V	P-Y-1	S	P-N	P-U
L. EF Rader Cr	2037	P-N	P-N	P-N	P-N	P-U
L. Little Wolf I	0285C	P-N	P-Y-2	V	P-N	P-Y-0
L. Little Wolf II	1894A	P-N	V	P-N	V	S
L. Miner Creek	1926	P-N	P-N	P-N	P-N	P-N
Miner Creek	0279	P-Y-0	P-Y-0	P-U	P-Y-1	P-N
Rader Creek	0275	P-Y-2	S	P-N	P-Y-2	P-U
Riverview	0281	P-Y-2	P-N	S	P-U	P-U
U. Cougar Cr	1805	U	V	V	V	U
U. Little Wolf	0388	P-N	P-Y-2	P-N	P-N	P-N
Western Cougar	2082	P-N	P-Y-2	P-U	P-N	P-N
Whiskey Camp Cr	0278	V	P-N	P-N	P-N	P-Y-2
Wolf Creek	0385	P-N	S	S	P-N	P-N

(Pair status: P=pair,S=single,U=unknown,V=vacant)
(Nesting status: Y=yes, N=no, U=unknown; #=number of juveniles)

3. There are approximately 11,789 acres of suitable marbled murrelet habitat within the drainage. During the 1992-5 breeding season, ten marbled murrelet survey sites were established in the drainage following the protocol of Ralph et al. (1993). The murrelet survey sites (Rader Creek, Wolf Creek, Bateman Ridge, Case Knife, Miner Creek, Lower Miner Creek, East Wolf Trib, Lower Wolf Creek, New Quarry, and Little Wolf Creek MAMU intensive survey sites) are located in T24S, R07W, T24S, R08W, and T25S, R08W. There is one known occupied/nest site within the drainage and is located in T24S, R08W, section 10, and should be managed within the guidelines of the Northwest Forest Plan (USDA and USDId 1994).

4. Within the drainage there are 17,222 acres of designated "critical" habitat for the northern spotted owl and the marbled murrelet. Both the "critical" habitat for the spotted owl and the marbled murrelet should be managed in a manner that does not adversally modified its present or future potential use for both the owl and the murrelet.

5. Potential bald eagle habitat within the drainage and managed by the Bureau is located in four sections and are within a mile of the Umpqua River. There is a total 382 acres of old-growth habitat (i.e. 195+ years old), and they are located in seven ecologically distinct patches and patch size ranges from 10 acres to 123 acres. Included within this acreage is part of the Cougar Creek bald eagle site. The site was located in 1982 and involves approximately 293 acres within the Cougar Creek drainage. During the last fourteen years this site has been very successful in fledgling young. Potential threats to the site involve the logging of a known nest tree on private land and logging the adjacent habitat stand which is located next to BLM and another known nest tree. This year the pair move to a third nest tree (i.e. new nest tree). The specific location of the nest tree is unknown, but is either in southern portion of section 12 or the northern portion

of section 13. See recommendation for specific solutions.

6. The big game habitat in the drainage consists of approximately 57% optimum habitat, 24% thermal cover, 13% hiding cover, and 6% a foraging habitat (i.e. from an elk perspective). Road density in the drainage is 4.8 mile/square mile (Table III-1), and in the near future private interest in the drainage will be harvesting their timber so the overall density of roads should increase. Based on observations during censusing (i.e. spot lighting in 1982-86) and conversations with Oregon Department of Fish and Wildlife poaching is a problem in this drainage and throughout most of the Coast Range. Lyon (1984) found in his study of elk in Idaho and Montana that their response to habitat quality is primarily determined by road densities, and modeling the variable predicted 50% of the variation in habitat use. In the Coast Range of Oregon, Cole (1996) during the limited access period of his study found a significant increase in the use of open, foraging habitats and areas <150m from roads. To promote more productive elk populations and to increase hunter opportunity Cole (1996) recommend limited-access management to maximize benefits and reduce poaching.

Wildlife Inventory/Information Needs for subsequent analyses, planning, or decisions:

Prior to initiation of any proposed actions such as a ground disturbance activity or one that is extremely noisy, that is within a quarter of a mile of suitable marbled murrelet habitat and has not been surveyed, we need to either seasonally restrict (i.e. those actions that are too noisy) or initate the appropriate surveys of all potential murrelet habitat to protocol standards, and determine the level of avian activity at the site(s)--absence--detections--occupied (see protocol and definitions developed by Ralph et al. 1993).

Reference condition and Desired Future Condition within the drainage:

The reference condition in the watershed is the potential or assumed conditions of the land prior to forest development for timber production, and is based on the resource area silviculturist anaylsis of the 1959 aerial photos. Due to its physical isolation and probably market conditions the watershed was not intensive developed for timber production until 1943. After taking into account harvesting activity between 1943 and 1959 the silviculturist estimate that nine percent of the federal lands in the watershed were early seral stage and 91% of the land was in mid seral to late successional stage (see the silviculturist report for further discussion).

The desired future condition in the drainage is to maintain and improve, within the guidelines of the ROD, the habitat for northern spotted owls, marbled murrelets, big game, and neotropical birds. The distribution of the spotted owl is well known as RWC, in cooperation with USFS, has had a 100 percent survey conducted since 1988. The current distribution of the marbled murrelet in RWC is partially known as there are presently only ten inventory sites in the drainage. In 1994, one of our inventory efforts in Rader Creek produced the furthest known inland nest site in western Oregon. In addition, during the past two years inventory sites in the Miner Creek and the Csse Knife Creek drainages have had detections observed during morning surveys. Big game can be found through out the drainage with little opportunity for improving their distribution or abundance. There is a variety of neotropical birds found through out the drainage, with limited opportunities for improving their distribution or abundance.

Within the drainage the major habitat variables that influence the utility of the land for the spotted owl and the marbled murrelet are age, structure, availability, and fragmentation of suitable habitat. The major limiting factor for big game is the quality and quantity of foraging habitat in the drainage. The neotropical bird community in the late-successional habitat is limited by the distribution and availability of 3-tiered stands (three layered canopy) and the distribution, availability, and the development of the shrubby/brushy habitat in the lower canopy.

VIII. HUMAN USES

RECREATION OPPORTUNITY SPECTRUM

The entire RWC falls within the Roaded Natural category of the Recreation Opportunity Spectrum (ROS). The area is characterized by a generally natural environment with moderate evidence of the sights and sounds of man. Resource modification and utilization practices are evident, but harmonize with the natural environment. Concentration of users is low to moderate with facilities sometimes provided for group activities. Rustic facilities are provided for user convenience as well as for safety and resource protection. Conventional motorized use is provided for in construction standards and design of facilities. (BLM Manual 8320)

OFF HIGHWAY VEHICLE DESIGNATIONS (OHV)

A small portion of the RWC area falls within the boundaries of the Hubbard Creek Off Highway Vehicle (OHV) (Figure VIII-1) area. This includes portions of Sections 18 and 19 in Township 25S, Range 7W and Section 25 of Township 25S, Range 8W. According to the Roseburg Record of Decision and Resource Management Plan (ROD RMP 1995), Registered (not necessarily State licensed) vehicles such as all terrain vehicles and motorcycles are allowed to travel on rocked and natural BLM maintained roads. All Progeny Test Sites are closed to Off Highway Vehicle use. These sites are fenced and should be signed. For the remainder of the WA area, OHV use is "limited to existing roads and trails". (BLM Manual 8340).

REREATION DESIGNATIONS

SPECIAL RECREATION MANAGEMENT AREA (SRMA)

The Umpqua River Special Recreation Management Area (SRMA) includes the Rader-Wolf Creek drainage. According to the Roseburg District Resource Management Plan (ROD RMP 1995), recreation is intensely managed. Objectives are to "identify, plan and implement high priorities for recreational and interpretive opportunities for the public, emphasizing camping, picnicking, hiking, nature study, interpretation, watchable wildlife, driving for pleasure, horseback riding, mountain biking, fishing, swimming ...".

The Miner Wolf Watchable Wildlife Site (MWWWS) is in the portion of the SRMA that is located in the RWC area. This relatively new site consists of a vehicle parking area, a vault toilet, a 1400 foot trail, several benches and a picnic table (Figure VIII-1).

The Loon Lake Back Country Byway is a proposed project that should have little impact on the environment. The only things planned are signs, brochures and an occasional interpretive display (Figure VIII-1).

EXTENSIVE RECREATION MANAGEMENT AREA (ERMA)

The remainder of the watershed falls in the Tyee ERMA, which means there is only a limited commitment of resources to recreation. There are no existing recreation sites in the portion of the ERMA that falls in the analysis area.

Dispersed Recreation Use: Dispersed recreation use range from hunting and fishing to hiking, camping, boating, swimming, sight-seeing, and wildlife viewing. The primary recreational activity within this WA is big game hunting. Big game species include Black-tailed deer, Roosevelt elk and Black bear. Small game that are common to this area are grouse, quail, squirrel and rabbit.

Areas of Critical Environmental Concern (ACEC): None exist in this WA area.

Wild and Scenic River (W&SR): None exist in WA area.

VISUAL RESOURCE MANAGEMENT (VRM)

The entire WA area is categorized as VRM class IV. The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance and repeating the basic elements.

HISTORIC HUMAN USES

There is archaeological evidence that human influence in this area began approximately 8,000 years ago. At that time the climate was cooler and wetter and the primary tree species were White Pine and Sitka Spruce. Some 4,000 years ago there was a gradual climate change and the dominate tree species changed to Douglas fir and Ponderosa Pine in the highlands and White oak in the valleys. Little is known about the inhabitants previous to the 20th century because along with the immigration of Europeans came the introduction of diseases that annihilated whole populations of aboriginal indians. The remnants of local tribes were forced onto reservations around 1855.

Four groups of indians occupied the Umpqua Valley. The Kalawatsets resided along the lower Umpqua River. The Yoncalla lived close to Elk and Calapooya Creeks. The Southern Molalla dwelt in the upper North and South Umpqua River drainage. Athabaskan speaking indians lived in the lower South Umpqua and Cow Creek areas. Few natives actually dwelled in this particular watershed. The Kalawatsets, Yoncalla and Athabaskan tribes likely travelled through this area following fluctuating food sources (such as Salmon runs and Elk migrations).

David Douglas, famed Botanist, studied the growth rings in ancient trees and deducted that the early natives repeatedly burned large areas of forest. He surmised they were converting timber stands into grasslands.

The first white settlers arrived in the mid 1800's. They farmed the valleys and trapped wherever they could. Camp Creek, a nearby drainage, got its name in 1853 because it was a good place to camp when travelling from the Tyee area to Loon Lake. Rader Creek was named in 1880 after a pioneer family that homesteaded at the headwaters of that creek. Later, the discovery of gold lured people to this area, thus the name Miner Creek. Finally, timber became the great attraction. In the 1930s roads and logging camps were built by the Civilian Conservation Corps. Remains of some of these camps still exist on private property (Figure VIII-1).

I will use the early 1800's as a point of reference because historical information indicates there was very little change in the environment previous to this time. Major changes in the environment resulted from European influence post 1800.

Following is a chronology of human events in this watershed area:

1800's	Three Indian tribes "shared" this watershed.
1820	European explorers began travelling through the watershed.
1836	Hudson's Bay Fort Umpqua established. Extensive trapping began in this WA area.
1859	First ranch along Wolf Creek was built.
1870	Arrival of the railroad. This created a boom in population in the small towns surrounding this watershed,
Late 1880's	William Rader homesteaded at the head of Rader Creek (Figure VIII-1).
1909	Trail or wagon road along Wolf Creek and Rader Creek was constructed.
1933	Civilian Conservation Corps constructed logging roads branching out from the river roads.
1943	A community sawmill was constructed on Wolf Creek. A small logging town was established. The sawmill was later purchased by Roseburg Lumber Co (Figure VIII-1).
1962	The Tyee Access Bridge was constructed.

FUTURE TRENDS IN HUMAN USAGE

Big game hunting in this watershed is expected to decline. Elk, deer and other animal habitat is expected to decrease with the change in logging practices as it relates to a projected decrease in available forage habitat.

A slight increase in human usage is expected along the riparian corridors as more recreation opportunities are created and fish habitat is improved.

Overall, the usage will remain constant with higher concentrations of people along Wolf Creek and Rader Creek and fewer people in the other areas.

Road densities average 4.8 mi/mi^2 (Table III-1). Table VIII-1 gives a listing of road data within RWC.

Table VIII-1. Road data for the Rader-Wolf-Cougar WAU.

ROAD NO.	SEGMENT LENGTH IN MILES	OWNER	SUR-FACE TYPE[1]	WIDTH (ft)	MAINT. LEVEL 1-5 1=Low 5=High	CONST./ RENOV ATION DATE	AMOUNT OF USE H=HIGH M=MEDIUM L=LOW
23-8-28 B	0.06	BLM	BST				H
23-8-28 C	0.51	BLM	BST				H
23-8-28 D	0.11	BLM	BST				H
23-8-34.4	0.02	BLM	ASC				L
24-7-7 A	0.03	BLM	NAT	12	2	1963	L
24-7-7.1A	0.16	BLM	ASC		3		L
24-7-7.4	0.29	BLM	ASC	16	3	1976	L
24-7-17.1C	1.28	BLM	PRR	16	4	1970	L
24-7-17.1D	0.83	BLM	ASC	16	4	1973	L
24-7-17.1E	0.32	BLM	CSS	16	3	1971	L
24-7-17.2I	0.50	PRI	NAT	16	2	1968	L
24-7-17.2J	1.17	BLM	NAT	16	2	1968	L
24-7-17.2K	0.04	BLM	NAT	16	2	1968	L
24-7-18 B	2.11	BLM	PRR		3		L
24-7-18 C	1.31	PRI	PRR		3		L
24-7-18 D	1.06	BLM	PRR		3		L
24-7-18 E	0.12	BLM	PRR		3		L
24-7-18.2A	1.24	PRI	NAT	14	2	1951	L
24-7-18.2B	0.33	BLM	NAT		2		L
24-7-18.3A	0.60	BLM	ASC	16	3	1967	L
24-8-1.1 A	0.17	BLM	NAT	16	2	1963	L
24-8-1.3 C	0.12	BLM	ASC	16	2		L
24-8-1.4 A	0.56	PRI	PRR		3		L

24-8-1.4 B	1.18	BLM	ASC		3		L
24-8-3 A	0.26	BLM	NAT		3		L
24-8-3.1 A	0.22	BLM	ASC		3		L
24-8-3.1 B	0.12	BLM	ASC				L
24-8-10 A	0.91	BLM	CSS		3	1968	L
24-8-10 B	0.56	BLM	CSS		3		L
24-8-10.1A	2.5	BLM	CSS		3	1968	L
24-8-10.3A	0.79	BLM	ASC	16	3		L
24-8-10.4A	0.54	BLM	ASC	16	3		L
24-8-10.5A	0.09	BLM	ASC		3		L
24-8-11	0.88	BLM	ASC		3	1968	L
24-8-11.1A	0.11	BLM	NAT		2	1968	L
24-8-11.2A	0.19	BLM	NAT		2		L
24-8-12 A	0.34	BLM	ASC	16	3		L
24-8-13 A	0.29	BLM	NAT		2	1968	L
24-8-13.1A	0.47	BLM	NAT		2		L
24-8-15 A	1.27	BLM	NAT		2	1968	L
24-8-15.1A	0.77	BLM	CSS	16	3	1973	L
24-8-20 A	0.10	BLM	CSS		3	1930?	L
24-8-20 B	0.06	PRI	CSS		3		L
24-8-20 C	0.79	BLM	CSS	12	3	1970?	L
24-8-20 G	0.15	BLM	NAT		2		L
24-8-21.1A	0.29	BLM	CSS	16	3	1973	L
24-8-21.1B	1.33	BLM	CSS	16	3	1973	L
24-8-21.2A	5.01	BLM	ASC	20	3	1972	L
24-8-21.3A	0.62	BLM	ASC		3		L
24-8-23 A	0.26	BLM	NAT		2		L
24-8-23.2A	0.38	BLM	NAT		2		L
24-8-23.2B	1.94	BLM	NAT	16	2	1967	L

24-8-23.3A	0.13	PRI	ASC	16	3	1966	L
24-8-23.4C	0.43	PRI	ASC	16	3	1963	L
24-8-23.5A	0.94	BLM	ASC	20	3	1969	L
24-8-23.5B	1.25	BLM	ASC	18	3	1969	L
24-8-23.5C	1.72	BLM	NAT		2		L
24-8-23.6A	0.39	BLM	CSS	16	3	1969	L
24-8-24 A	0.96	BLM	ASC	16	3	1977	L
24-8-24.1A	0.46	BLM	ASC	16	3	1970?	L
24-8-24.2A	0.12	BLM	ASC	16	3	1990?	L
24-8-25.1	0.17	BLM	ASC	14	3	1969	L
24-8-25.1B	0.23	BLM	ASC	16	3	1969	L
24-8-25.2	1.37	BLM	ASC	16	3	1973	L
24-8-25.3	0.17	PRI	CSS	18	3	1972	L
24-8-26.4	1.06	BLM	ASC	16	3	1972	L
24-8-26.4B	1.36	PRI	ASC		3		L
24-8-27	1.82	BLM	ABC	16	3	1973	L
24-8-27.1	0.82	BLM	CSS		3		L
24-8-27.1B	0.83	BLM	ASC	14	3	1973	L
24-8-27.2	0.66	BLM	CSS	14	3		L
24-8-27.3	1.24	BLM	CSS		3	1972	L
24-8-28.2	0.44	BLM	NAT	14	2	1972	L
24-8-28.3	0.49	BLM	ABC	16	3	1972	L
24-8-29	0.39	BLM	ABC	17	3	1972	L
24-8-34	0.36	BLM	PRR	16	3	1972	L
24-8-34 B	0.52	BLM	CSS	16	3	1972	L
24-8-34 C	0.40	BLM	PRR		3	1973	L
24-8-34.1	2.9	BLM	ASC	16	3		L
24-8-35.1	0.19	BLM	ASC		3		L
24-8-35.1B	0.18	PRI	ASC		3		L

24-8-35.1C	0.70	PRI	NAT		2		L
24-8-35.1D	0.90	PRI	NAT		3		L
24-8-35.1E	0.32	BLM	PRI		3		L
24-8-35.1F	0.59	BLM	ASC		3		L
24-8-35.1G	0.60	PRI	NAT		2		L
24-8-35.1H	0.13	BLM	NAT		2		L
24-8-35.1H	0.14	BLM	ASC		3		L
24-8-35.1H	1.18	BLM	ASC		3		L
24-8-35.1I	0.61	BLM	ASC		3		L
24-8-35.1J	0.35	BLM	CSS		3		L
24-8-35.3A	0.23	BLM	ASC	16	3	1987	L
24-8-35.4A	0.29	BLM	ASC	16	3	1987	L
24-8-35.5A	0.41	BLM	NAT		2		L
24-8-35.6A	0.17	BLM	NAT		3		L
24-8-35.7A	0.08	BLM	ASC	16	3	1987	L
24-8-35.8A	0.17	BLM	ASC	16	3	1987	L
24-8-35.9A	0.22	BLM	ASC	16		1987	L
24-8-36 B	1.55	BLM	ASC	16	4		L
24-8-36 D	0.91	BLM	ASC		3		L
24-8-36.1B	0.02	BLM	ASC	16	3	1973	L
24-8-36.1C	0.22	BLM	ASC		3		L
24-10-29 F	0.45	BLM	ASC				L
24-10-29 H	0.15	BLM	ASC				L
25-7-5.1	9.54	BLM	BST	22	5	1963	H
25-7-6 A	.01	BLM	NAT		2	1971	L
25-7-16.2A	.01	BLM	ASC	16	4	1967	L
25-7-16.2B	.49	BLM	ASC	16	4	1972	L
25-7-16.2C	3.56	BLM	ASC	16	4	1972	L
25-7-16.2D	0.07	BLM	ASC		4	1972	L

25-7-18 A	0.47	BLM	CSS	16	3	1969	L
25-7-18 B	0.69	BLM	CSS	16	3	1971	L
25-7-18 C	0.25	BLM	CSS	16	3	1972	L
25-7-18.1A	0.63	BLM	PRR	14	3	1972	L
25-7-19 A	1.12	BLM	PRR	16	3	1972	L
25-7-19.1A	0.29	BLM	ASC	16	3	1980?	L
25-7-21 B	0.05	BLM	ASC	14	3		L
25-7-21 C	2.33	BLM	ASC	14	3	1970?	L
25-8-1 A	0.67	BLM	PRR		4		L
25-8-1 J	0.23	BLM	PRR		3		L
25-8-1.1 A	0.69	PRI	ABC		3		L
25-8-1.1 B	2.7	BLM	ABC		3		L
25-8-1.1 C	0.69	BLM	ABC		3		L
25-8-1.5 A	1.21	BLM	PRR		3		L
25-8-1.5 B	0.30	PRI	PRR		3		L
25-8-1.5 C	1.35	PRI	NAT		2		L
25-8-3 A	0.74	BLM	PRR		3		L
25-8-3.1 A	0.57	BLM	CSS		3		L
25-8-4 A	0.73	BLM	ASC		3		L

[1] Surface Type Definitions: NAT (Natural, dirt); GRR (Grid Rolled Rock); PRR (Pit Run Rock); CSS (Crushed Sandstone); ABC (Aggregate Base Course); ASC (Aggragate Surface Course); BST (Bituminous Surface Treatment, asphalt)

IX. MANAGEMENT RECOMMENDATIONS

Program specific managment recommendation were made by several of the specialists. Following are management recommendations that seek to alleviate program specific problems.

Fisheries and Hydrology

Information needs:

- Classify streams in the WAU by type using Rosgen (1994). Use this for comparison, a basis for extrapolation, prediction stream behavior, and design of stream enhancement structures.

- Determine bankfull discharge, meander width ratio of valleys, and belt width on all 4th order streams. Measure bankfull width, mean depth, width/depth ratio, maximum bankfull depth, entrenchment ratio, channel and valley slope, sinuosity, and channel material. Develop curves of bankfull channel dimensions versus drainage area for the region.

- Implement bioengineered stream stabilization improvements. Do not use rip rap for channel stability. Do not construct check dams. Stabilize bank erosion in main channels and decrease peak flow in unstable soil.

- Determine reference reaches in the watershed that are not influenced by management activities for comparison to reaches impacted by management.

- Conduct a thorough fish distribution survey in all tributaries, including draws that may not have obviously flowing water, to determine presence/absence of fish.

Rader-Wolf Subbasin

- Implement a program to place a minimum of 100 pieces of LWD (min. 24" diameter, 50 ft. length) per mile in all confirmed, fishbearing streams. This can be accomplished through a combination of utilizing windthrown/salvage trees and live tree pulling. Design placement of LWD to lower width/depth ratio, heighten belt width, lower radius of curvature, and shorten meander length. Set root wads parallel with the stream vortex and velocity vector and use them to decrease width/depth ratio and dissipate energy, provide a log footer under wad. Use cross wing deflectors to increase stream sinuosity. Use rock vanes to stabilize banks and slow streamflow and roll it. Use weirs to deepen up stream channels and constrict flow.

- Determine proper functioning condition of the riparian areas in the WAU. Convert selected riparian hardwood areas to conifer and thin stands of conifer in riparian reserves (specific sites and trees to be determined) to enhance/speed up the natural attainment and recruitment of LWD

- Transplant unwanted beavers from other areas into basin; allow beavers to build and maintain their dams (except near inlets to culverts).

- Replace all culverts which are undersized, rusted out, and/or plugged up, to provide for juvenile fish passage; replace cross drains; and clean and realign drainage ditches as needed (specific culverts to be identified). When installing new culverts do not constrict flow through a single culvert, instead install multiple culverts if necessary to match upstream width/depth ratios.

Known culverts for replacement:
- Little Wolf Creek, south upper fork
    - T25S-R8W Section 9, crossing 25-8-9.1 road, two pipes
- Little Wolf Creek tributaries, about 4 miles above Wolf Creek
    - T25S-R8W Section 3, two pipes on 25-8-1.1

Known culverts for cleaning out:
- Tributary to Rader Creek Tributary #1
    - T24S-R7W Section 19, crossing 17.1 road, 3.9 miles from the 25-7-5.1 road
- Little Wolf Creek, south upper fork (same as above)
    - T25S-R8W Section 9, crossing 25-8-9.1 road, two pipes

Known road fill removal needed:
- Tributary to Rader Creek Tributary #1
    - T24S-R7W Section 7, stream crossing on unnamed/unnumbered road, coming off of the junction of the 18.0 and 7.4 roads, has road fill in stream, with NO CULVERT. Actively eroding and dumping sediment into stream.

- Rehabilitate Little Wolf Quarry. Activity in quarry during Fall '95 - Spring '96 caused a significant amount of fine sediment to end up in Little Wolf Creek.

- Put together and conduct a strategy for effectiveness monitoring of the existing fish structures within the basin. Ensure that effectiveness monitoring is put into future in-stream structure considerations.

Cougar Creek Subbasin
- Determine proper functioning condition of the riparian areas in the WAU. Convert selective riparian hardwood areas to conifer, thin stands of conifer in riparian reserves and pull large trees into stream to enhance/speed up the attainment and recruitment of LWD.

- Identify source(s) of sediment and sand in area of confluence of Cougar Creek and Cougar Creek Tributary #1; take steps to minimize/correct problem.

- Transplant unwanted beavers from other areas into basin; allow beavers to build and maintain their dams.

- Replace all culverts which are undersized, rusted out, plugged up or misaligned; of special note -- three culverts on known fish-bearing tributaries on BLM road 25-8-1.0; two at the boundary of sections 21 and 22, and one at the intersection of BLM road 15.3 at the boundary of sections 15 and 16. When installing new culverts there may be some streams where the flow should not be constricted through a single culvert, instead install multiple culverts to match upstream width/depth ratios.

Wildlife

Improving habitat for big game in RWC would require the development and implementation of aroad management plan and the coordination of that plan with the adjacent landowners. The road management plan may require that a number of spur roads be closed and an effective system of gates be established. In addition, we could increase the amount of availableforage with the use of under-planting and road-side planting of native grasses and legumes. Although the implementation of the planting is a low priority it could be implemented during the normal road maintenance and construction activities.

To improve habitat for the spotted owl and marbled murrelet we need to reduce, and where possible eliminate the affects of fragmentation on the birds.

To improve the habitat for bald eagles within the drainage would require that the Bureau acquire, through land exchange or purchase, the forest property owned by Roseburg Resources in the SE of SE of section 12 (T.25S., R.08W.). The proposed exchange was identified in the 1983 MFP and the 1995 RMP for the Roseburg District.

Approximately 30 miles (Table IX-1) of road, on Federal lands, have been identified as having the potential to be closed for wildlife protection.

Table IX-1. RMP identified, potential road closures within the Rader-Wolf-Cougar WAU.

Road Number	Segment	Length[1] (mi.)	Dates closed to public	Rationale	Surface type
24-7-17.1	E	1.00	year round	protect wildlife habitat	rock
24-7-18.1	A	0.70	year round	protect wildlife habitat	rock
24-7-18.2	all	1.00	year round	protect wildlife habitat	rock
24-7-5.3	all	0.40	year round	protect wildlife habitat	rock
24-7-5.4	all	0.35	year round	protect wildlife habitat	rock
24-7-6.6	all	1.05	year round	protect wildlife habitat	rock
24-7-8.1	all	0.53	year round	protect wildlife habitat	rock
24-7-8.2	all	0.10	year round	protect wildlife habitat	rock
24-7-9.3	all	0.50	year round	protect wildlife habitat	natural
24-7-4.2	all	1.30	year round	protect wildlife habitat	rock
24-8-10.1	all	2.00	year round	protect wildlife habitat	rock
24-8-10.3	all	1.00	year round	protect wildlife habitat	rock
24-8-11.0	all	0.90	year round	protect wildlife habitat	rock
24-8-1.1	all	0.26	year round	protect wildlife habitat	natural
24-7-13.1	all	0.30	year round	protect wildlife habitat	natural
24-8-23.2	all	2.30	year round	protect wildlife habitat	natural

24-8-15.0	all	1.27	year round	protect wildlife habitat	natural
24-8-13.0	all	0.30	year round	protect wildlife habitat	natural
24-8-21.2	A	4.40	year round	protect wildlife habitat	rock
24-8-28.2	all	0.36	year round	protect wildlife habitat	natural
24-8-28.3	all	0.24	year round	protect wildlife habitat	rock
24-8-29.0	all	0.41	year round	protect wildlife habitat	rock
24-8-26.4	A	0.60	year round	protect wildlife habitat	rock
24-8-27.3	all	1.31	year round	protect wildlife habitat	rock
24-8-28.0	all	0.40	year round	protect wildlife habitat	rock
24-8-35.2	all	0.07	year round	protect wildlife habitat	natural
24-8-35.4	all	0.39	year round	protect wildlife habitat	rock
24-8-34.0	B&C	1.26	year round	protect wildlife habitat	rock
24-8-34.1	A	0.50	year round	protect wildlife habitat	rock
25-8-4.0	all	0.77	year round	protect wildlife habitat	rock
25-8-3.0	all	0.55	year round	protect wildlife habitat	rock
25-8-3.1	all	0.66	year round	protect wildlife habitat	rock
25-8-1.1	all	0.70	year round	protect wildlife habitat	rock
25-8-9.0	all	0.51	year round	protect wildlife habitat	rock
25-8-9.1	all	0.58	year round	protect wildlife habitat	rock
25-8-10.8	all	0.15	year round	protect wildlife habitat	rock
25-8-10.7	all	0.47	year round	protect wildlife habitat	rock
25-8-10.9	all	0.15	year round	protect wildlife habitat	rock
25-8-10.10	all	0.17	year round	protect wildlife habitat	rock
25-8-15.5	all	0.13	year round	protect wildlife habitat	rock
Total =		30.65 miles			
[1] Mileage of road on BLM managed lands.					

Soils

Look at those road segments identified in Table II-14 and make efforts to correct the problems.

Integrated Management Recommendations

- Road closures/rehabilitation has been mentioned a number of places in this document. Road closures/rehabilitation need to be coordinated with wildlife concerns, road density issues, and erosional concerns. All these concerns need to be entered into the TMOs currently being completed for Engineering. A fully informed comprehensive transportation plan could then be completed.

- Efforts should be made to utilize logs cleared from blocked roads, in LSR, to supplement in-stream woody debris.

- Table 1 in Appendix 4 identifies 1334 acres of the 1393 acres of forest, between 25 and 45 years of age, that are likely to be suitable candidates for density management, that occur within 1.5 miles of a spotted owl core area. Currently 19, of the 30, owl core areas (original and all alternate owl core areas) are below guideline levels for incidental take (Table IX-2). Density management opportunities should be looked for that have the potential to improve the habitat opportunities within the provincial home range of a deficient owl core areas.

Table IX-2. Suitable owl habitat, on federal lands, within 1.5 miles of spotted owl core areas in the Rader-Wolf-Cougar WAU.

IDNO	AREA (acres)	IDNO	AREA (acres)
0275	1979.2	0288A	2110.3
0275A	1881.6 ‡	0385	2409.6
0277	1129.2 ‡	0386	1513.0 ‡
0277A	1106.2 ‡	0386A	1339.8 ‡
0278	2810.1	0388	1723.3 ‡
0279	2550.8	0388A	1660.5 ‡
0280	2357.2	0507	1397.3 ‡
0281A	1763.8 ‡	0507A	1792.9 ‡
0284	1057.0 ‡	1805	994.9 ‡
0285	2165.9	1894	1883.8 ‡
0285A	2190.4	1894A	1381.5 ‡
0285B	2396.4	1926	1272.6 ‡
0285C	2350.5	2037	1425.7 ‡
0285D	2336.8	2082	954.5 ‡
0288	1647.8 ‡	2208	1579.1 ‡

‡ Incidental take, according to USFWS guidelines, occurs below 1906 acres.

- Road/road surface owners should be notified of problems with their roads and every opportumity taken to work with adjacent owners to correct the problems.

- Monitor all management activities within LSR to insure that they are achieving the desired results, in accordance with the goals of LSR management.

- Prevent/control the spread of noxious weeds, in accordance with Federal statutes (Carlson-Foley Act of 1968, Federal Noxious Weed Act of 1974, FLPMA 1976) and Bureau direction (BLM Manual 9015). Control activities might include:

  - Clean all machinery prior to entry on to Federally managed lands.
  - Actively monitor quarry sites and gravel stockpile areas within the RWC and use appropriate control methods (manual pulling, mechanical treatments, biocontrols, herbicides).

- Critically review the need for new roads and spurs associated with all activities. Concers regarding the contruction of new roads and the rehabilitation of existing ones should consider mycological and mythelial (fungi and ecto micro-rhizomes) resources in addition to soil productivity.

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Location of the Rader-Wolf-Cougar watershed analysis area.

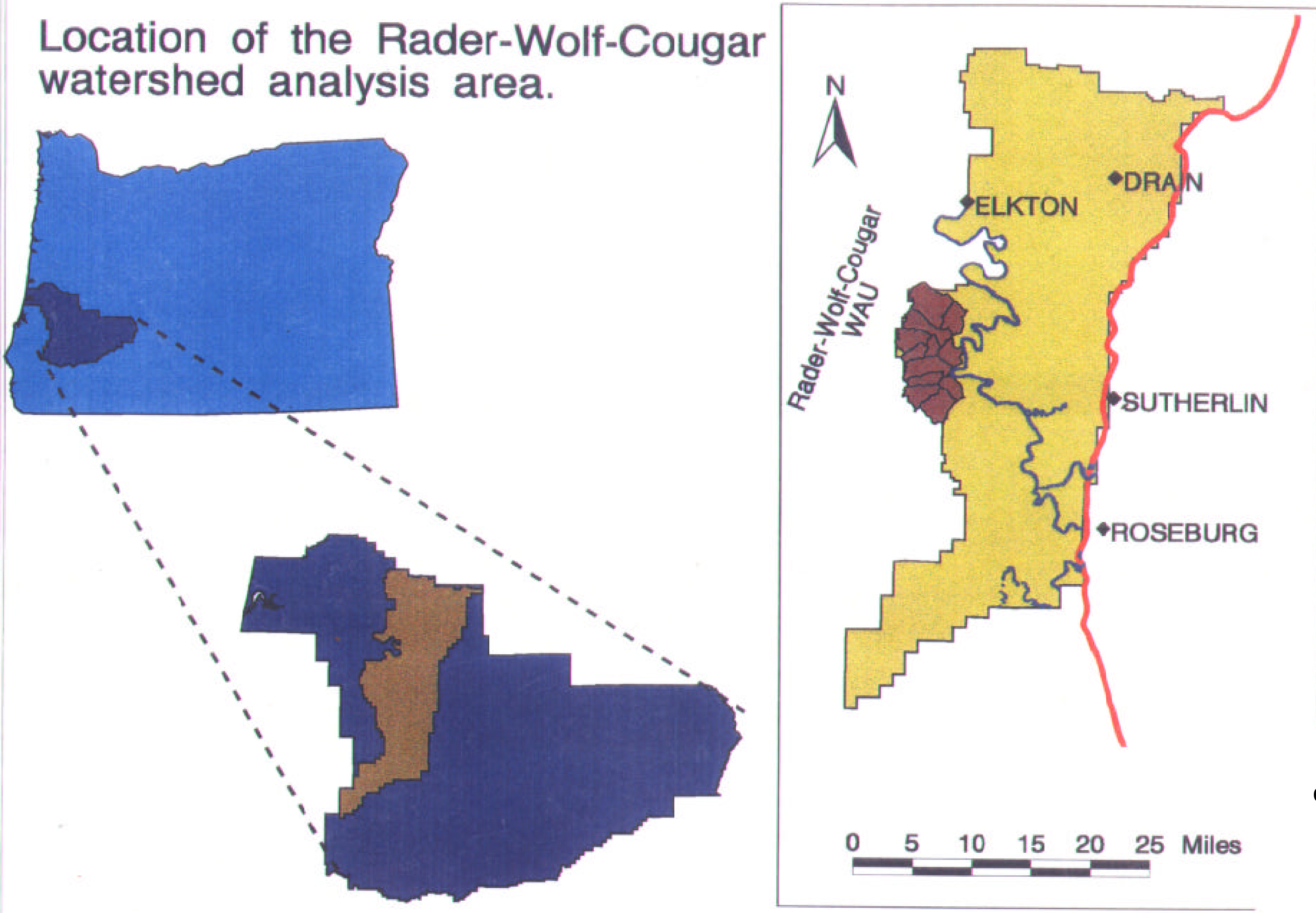


Figure I-1

The Rader-Wolf-Cougar Watershed Analysis Unit.

Figure I-2

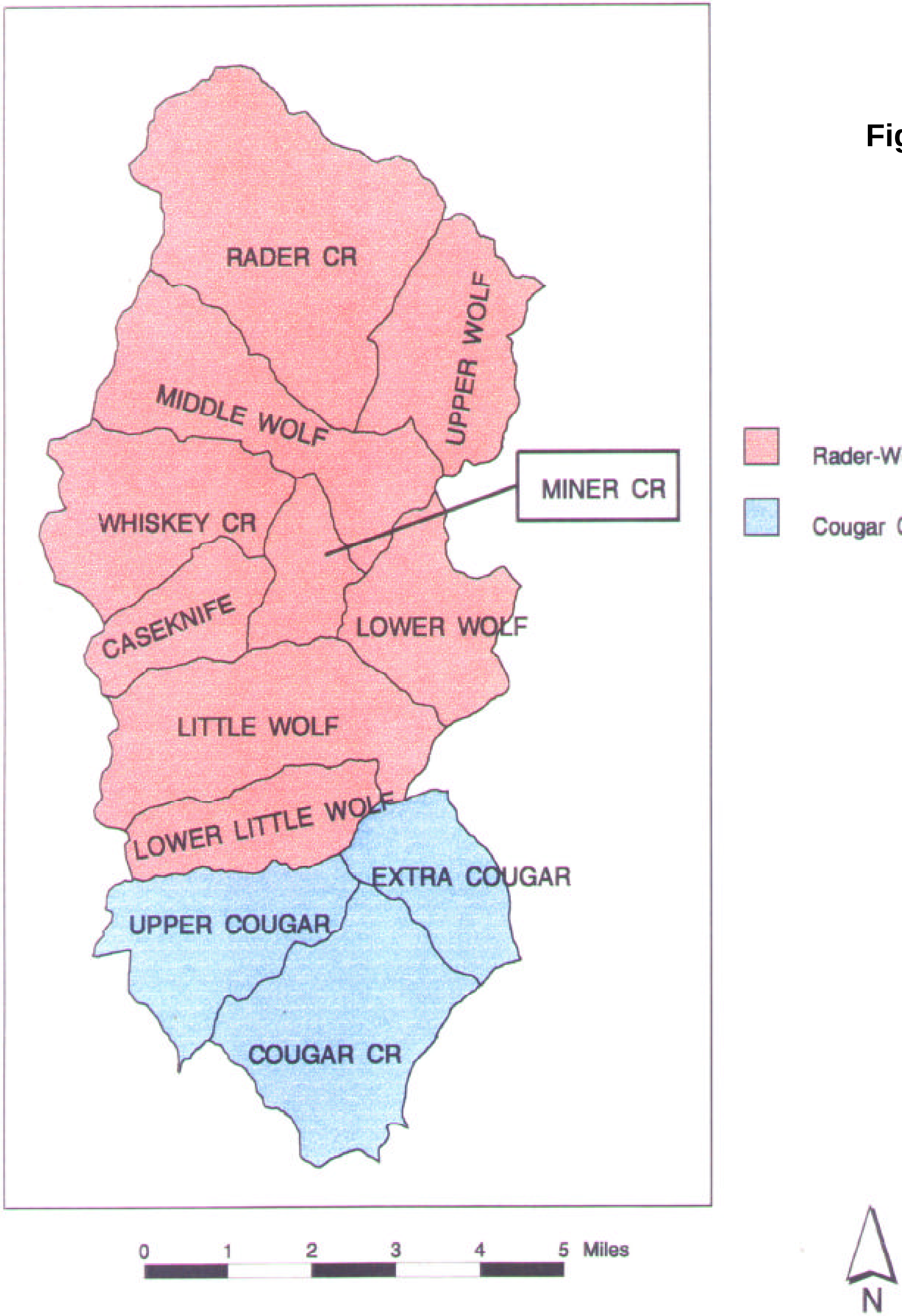
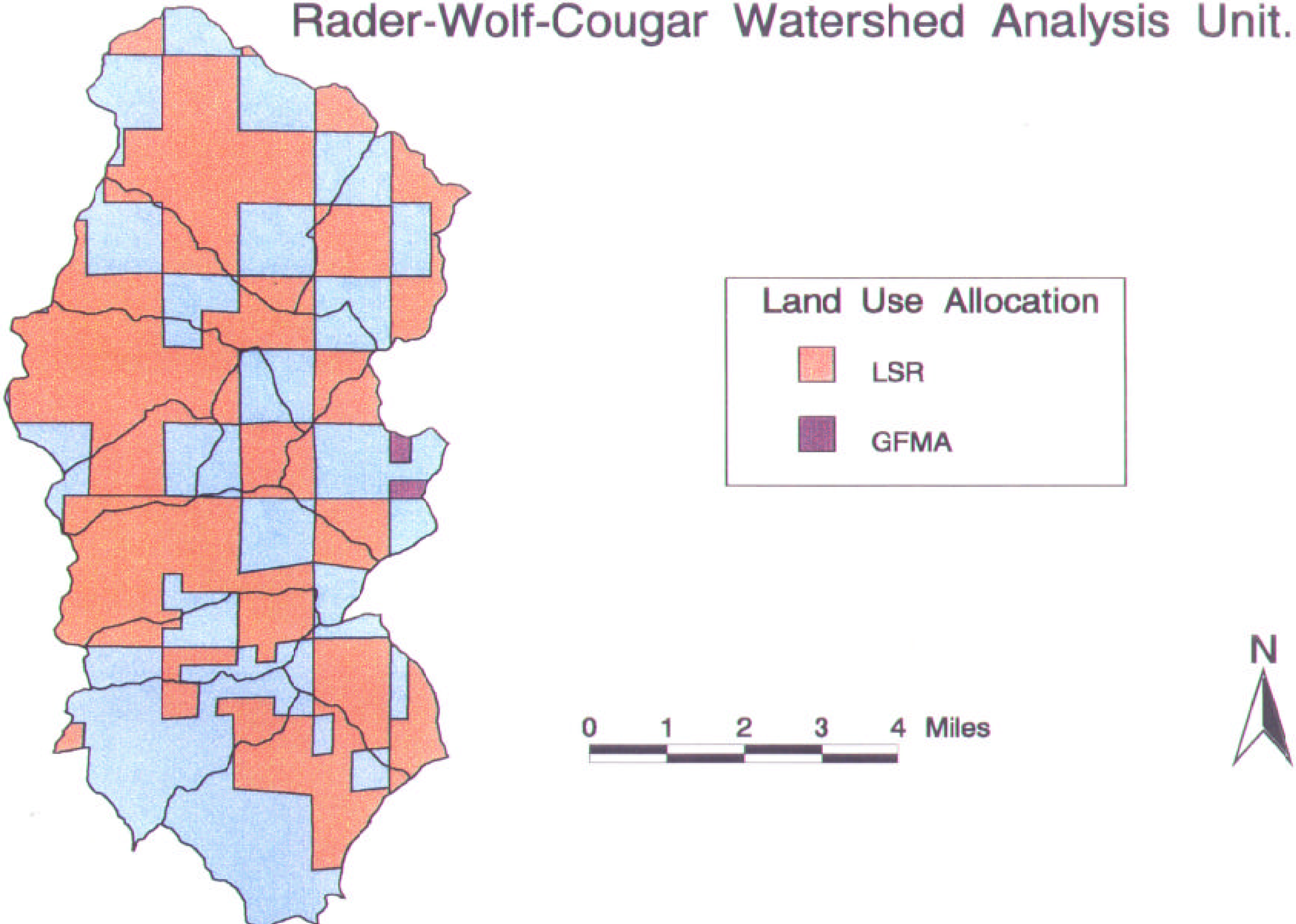
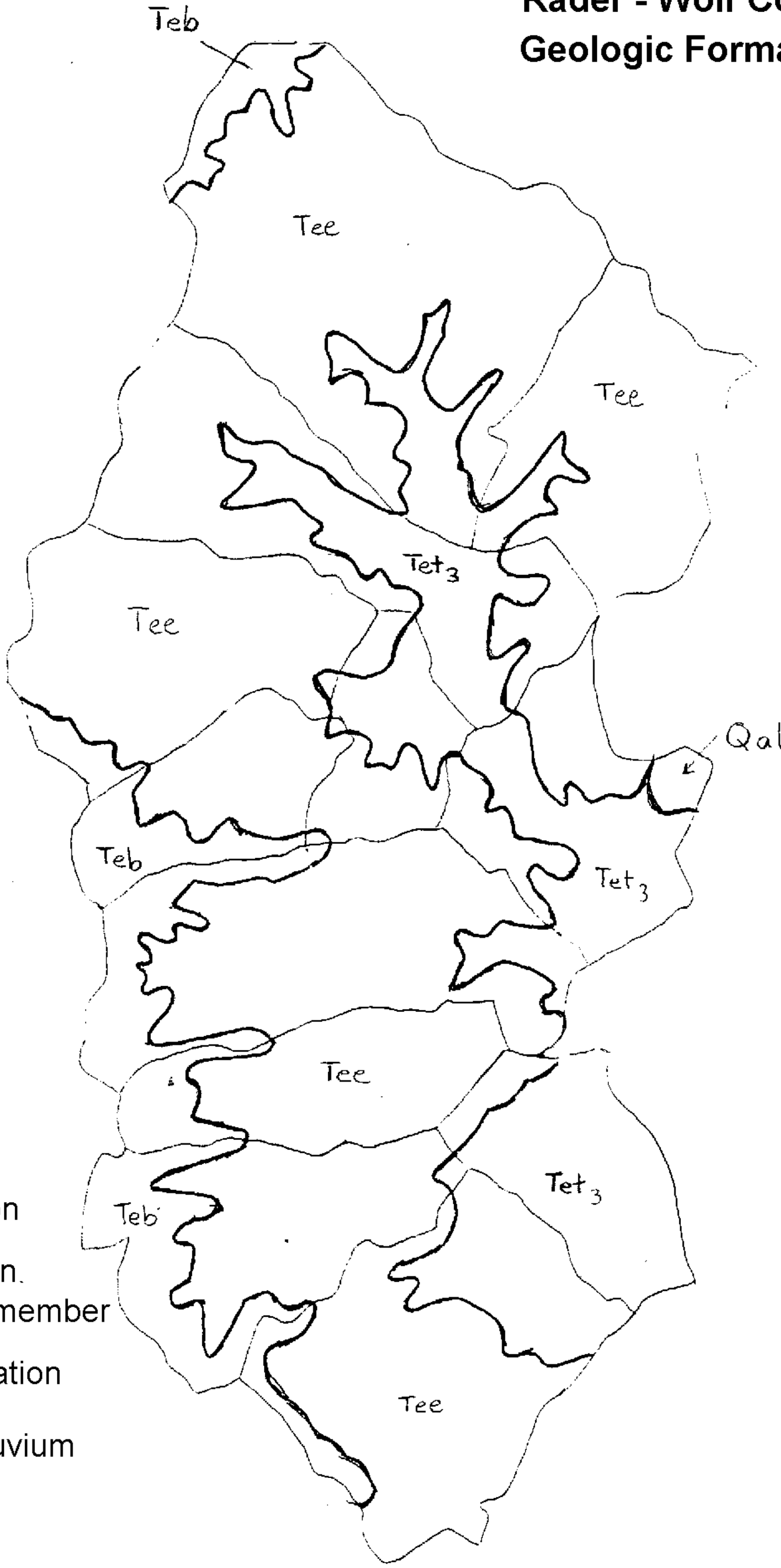


Figure I-3

Land use allocations within the Rader-Wolf-Cougar Watershed Analysis Unit.



Map # 1
Rader - Wolf Cougar
Geologic Formations



Tee = Elkton Formation

Tet-3 = Tyee Formation.
Baughman Lookout member

Teb = Bateman Formation

Qal = Quarternary Alluvium

Map # 2

Geologic Strata

Strike & Dip

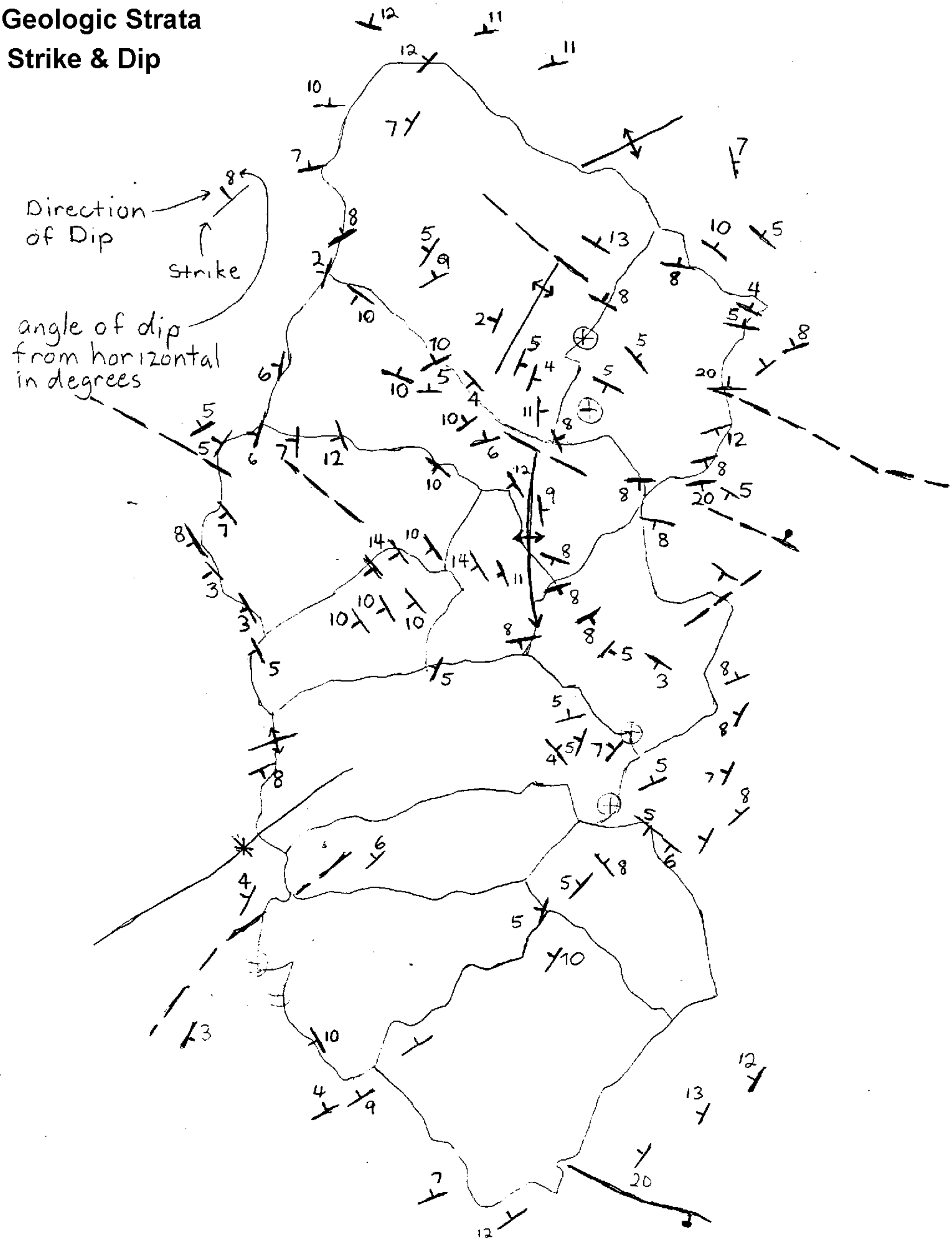
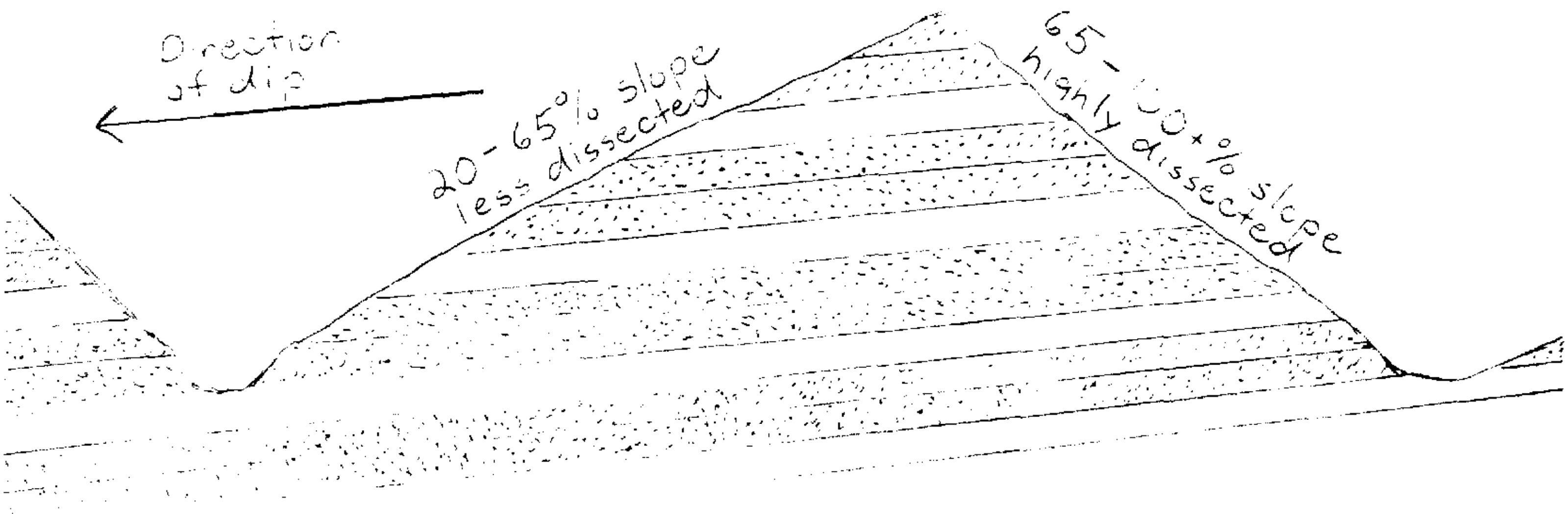
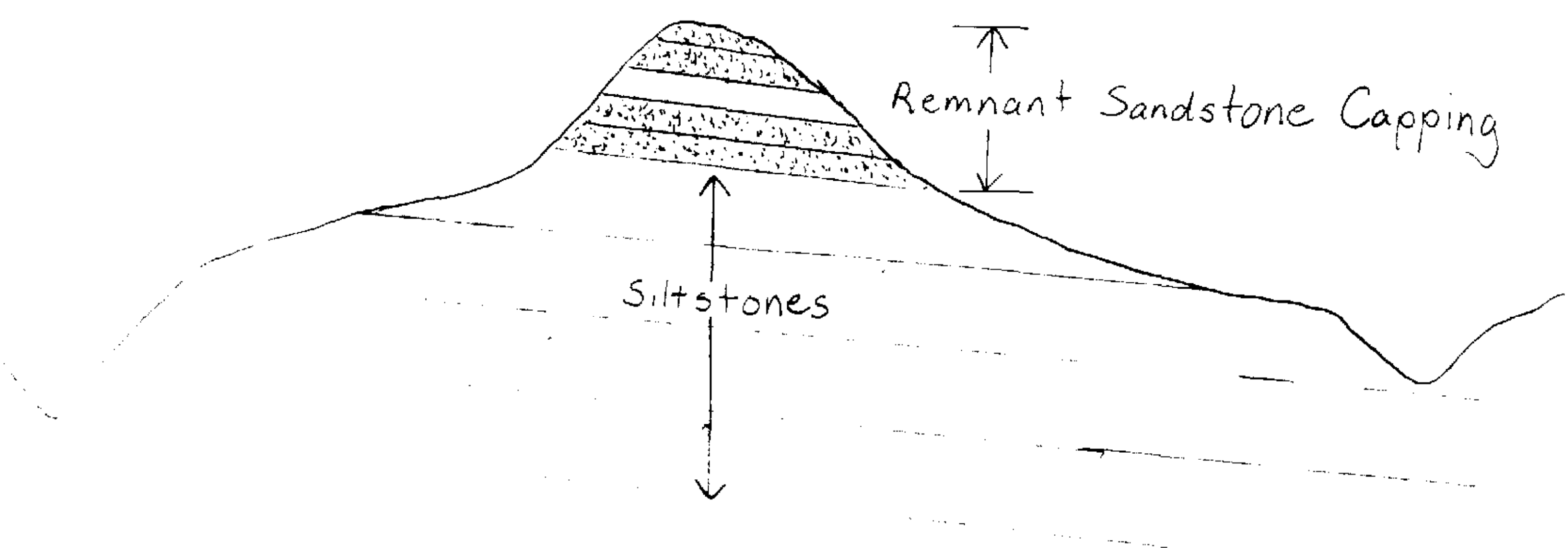


Figure II - Z(a-e)

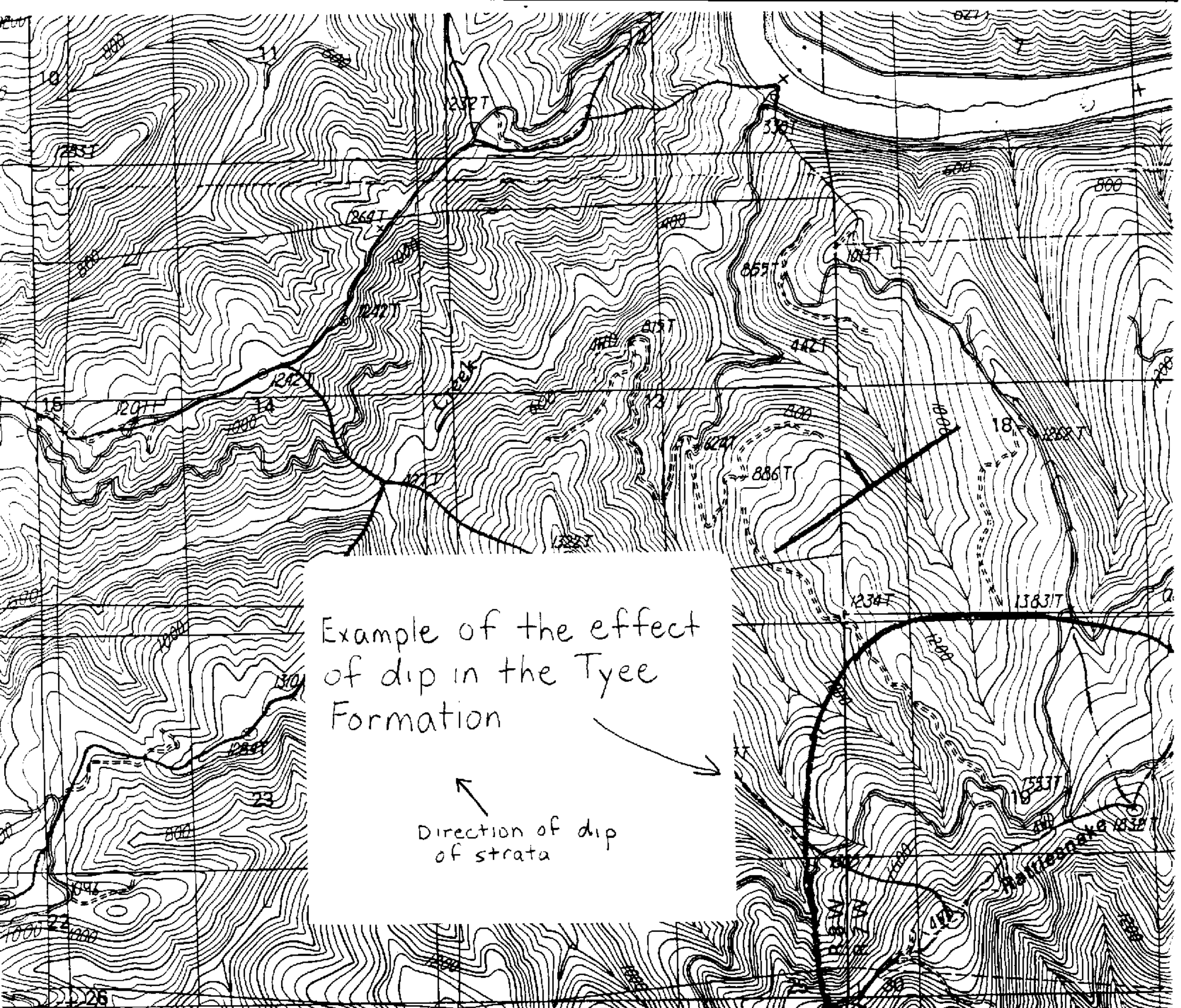
Characteristic Topographies

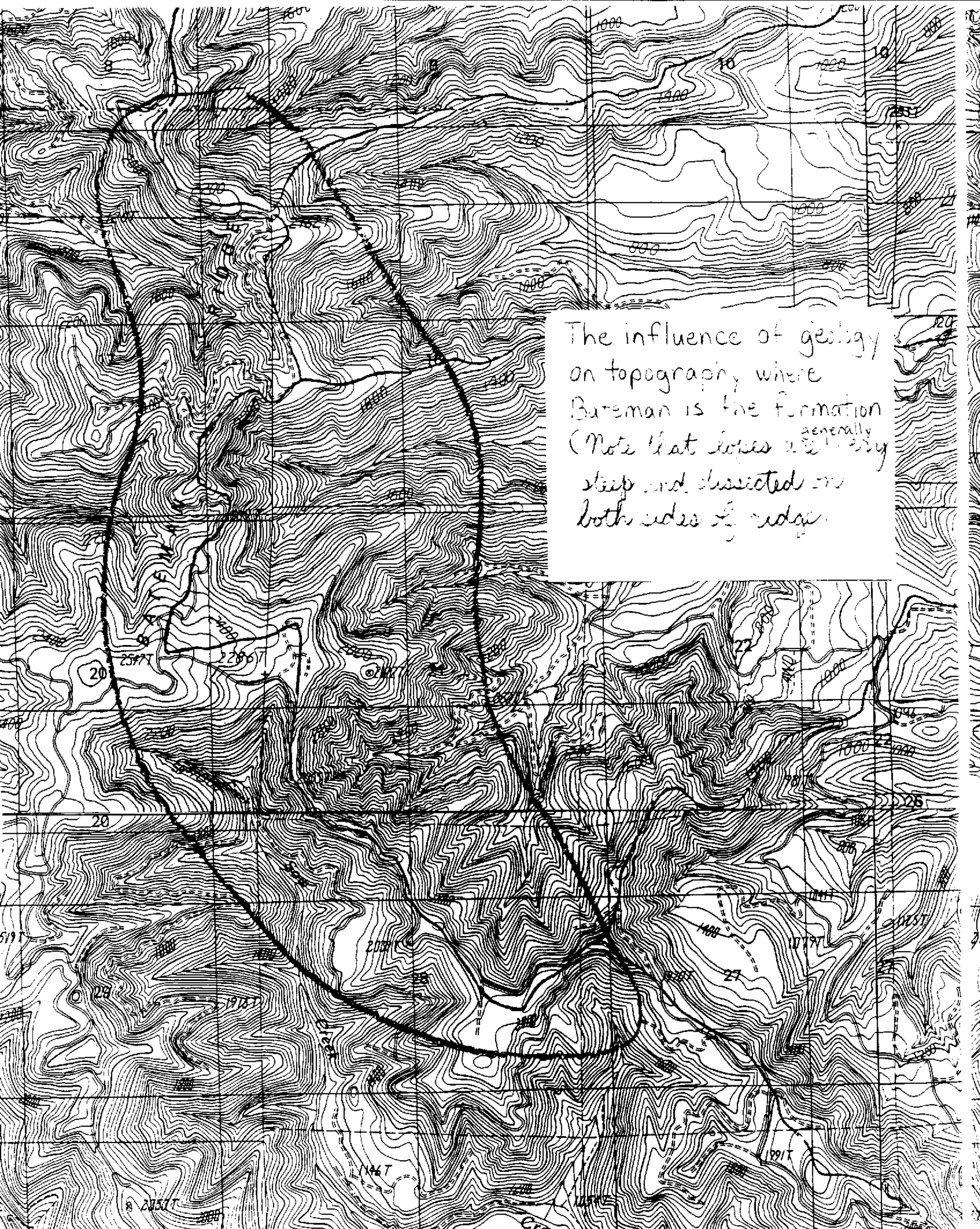


Tyee Formation consisting of sandstones interbedded with some siltstones



Elkton Formation


Example of the effect of dip in the Tyee Formation
Direction of dip of strata
Creek
Cougar
Creek
Rattlesnake
Ridge
Rattlesnake
Creek


The influence of geology on topography where Bateman is the formation (Note that slopes are generally steep and dissected on both sides of ridge.
Creek
4WD

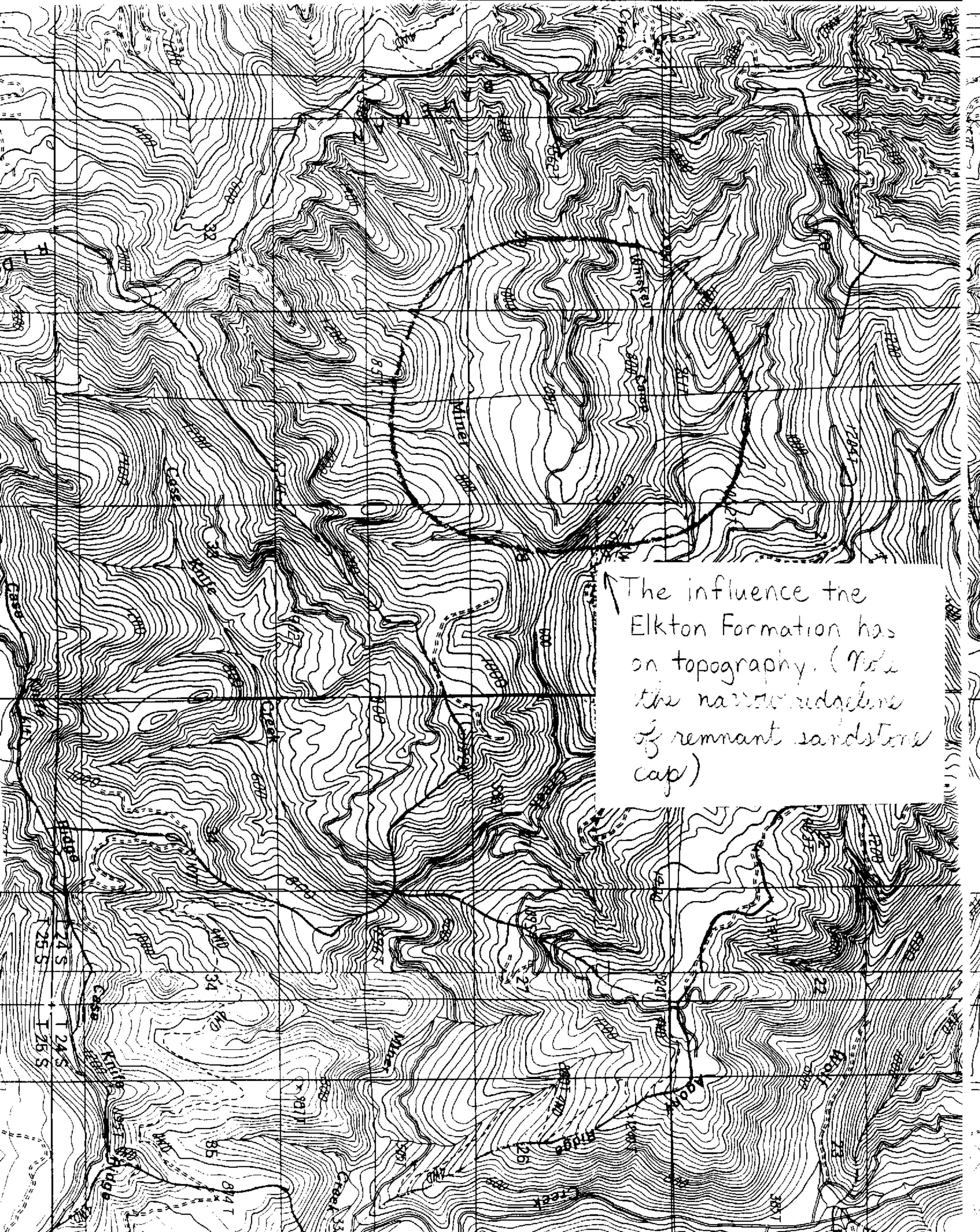
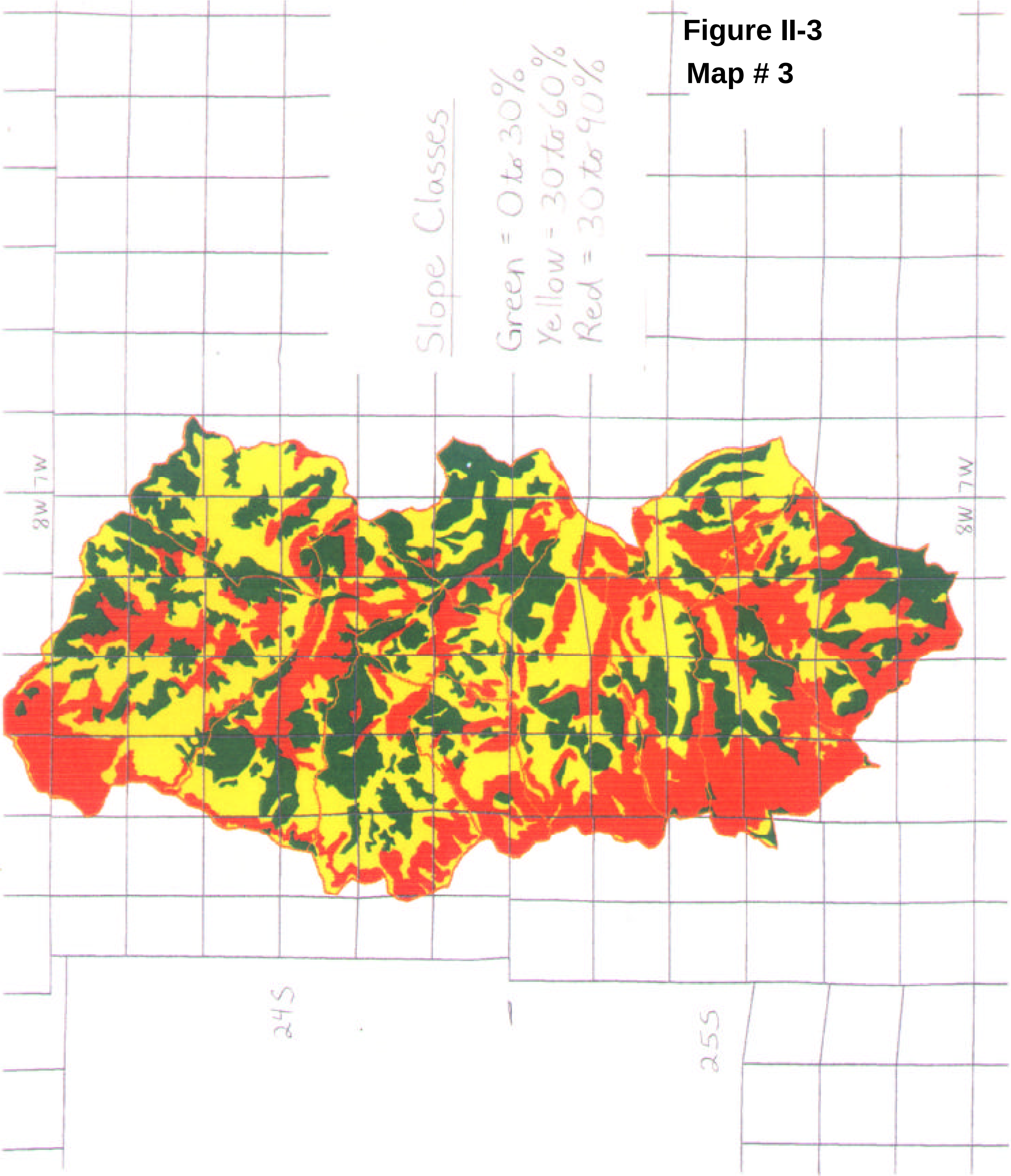
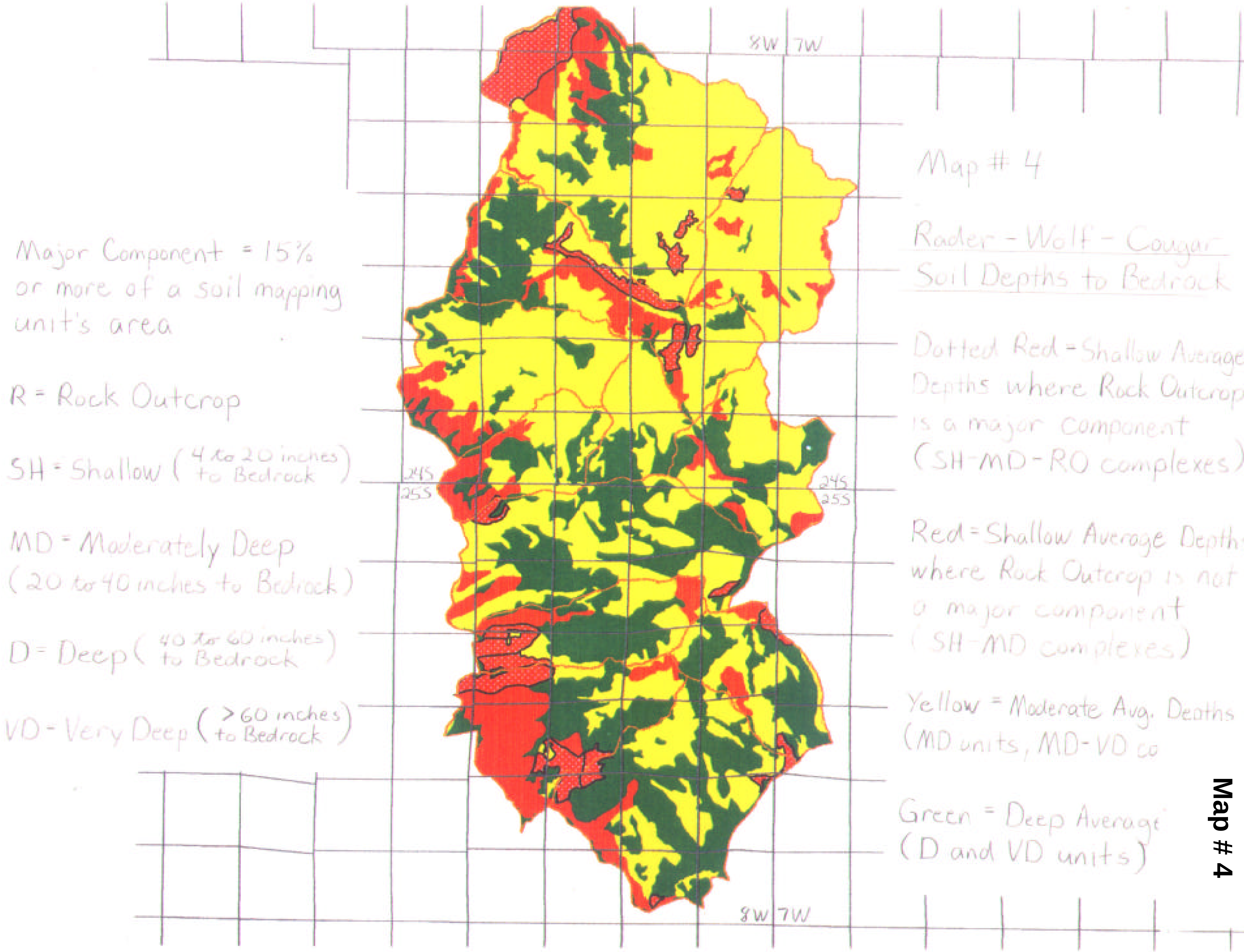

The influence the Elkton Formation has on topography. (Note the narrow ridgeline of remnant sandstone cap)

Figure II-3

Map # 3




Map # 4
Rader - Wolf - Cougar
Soil Depths to Bedrock
Dotted Red = Shallow Average Depths where Rock Outcrop is a major component (SH-MD-RO complexes)
Red = Shallow Average Depths where Rock Outcrop is not a major component (SH-MD complexes)
Yellow = Moderate Avg. Deaths (MD units, MD-VD co
Green = Deep Average (D and VD units)
Major Component = 15% or more of a soil mapping unit's area
R = Rock Outcrop
SH = Shallow (4 to 20 inches to Bedrock)
MD = Moderately Deep (20 to 40 inches to Bedrock)
D = Deep (40 to 60 inches to Bedrock)
VD - Very Deep (>60 inches to Bedrock)
8W 7W
24S
25S

Map # 4

Figure II - 5

Map # 5

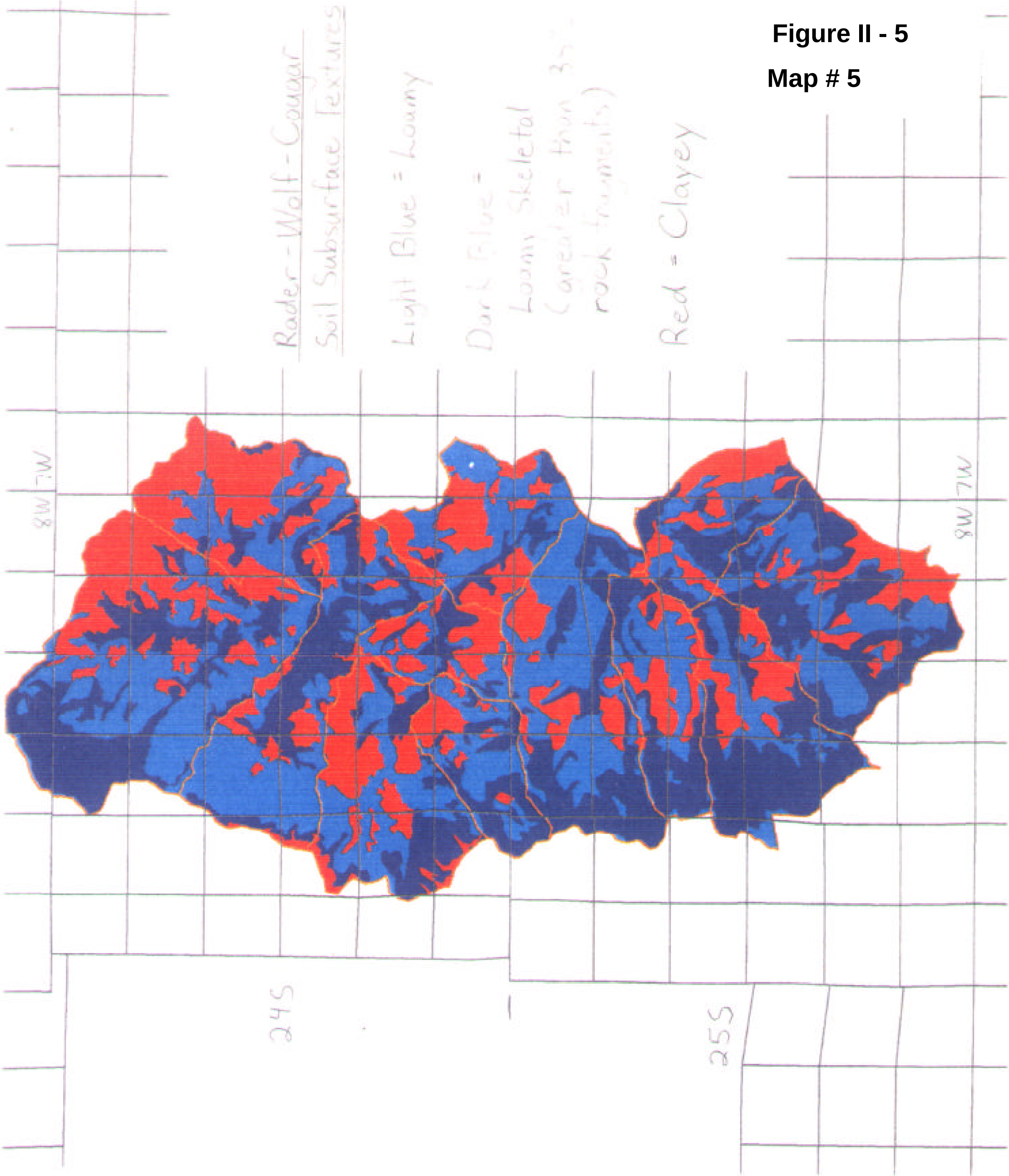
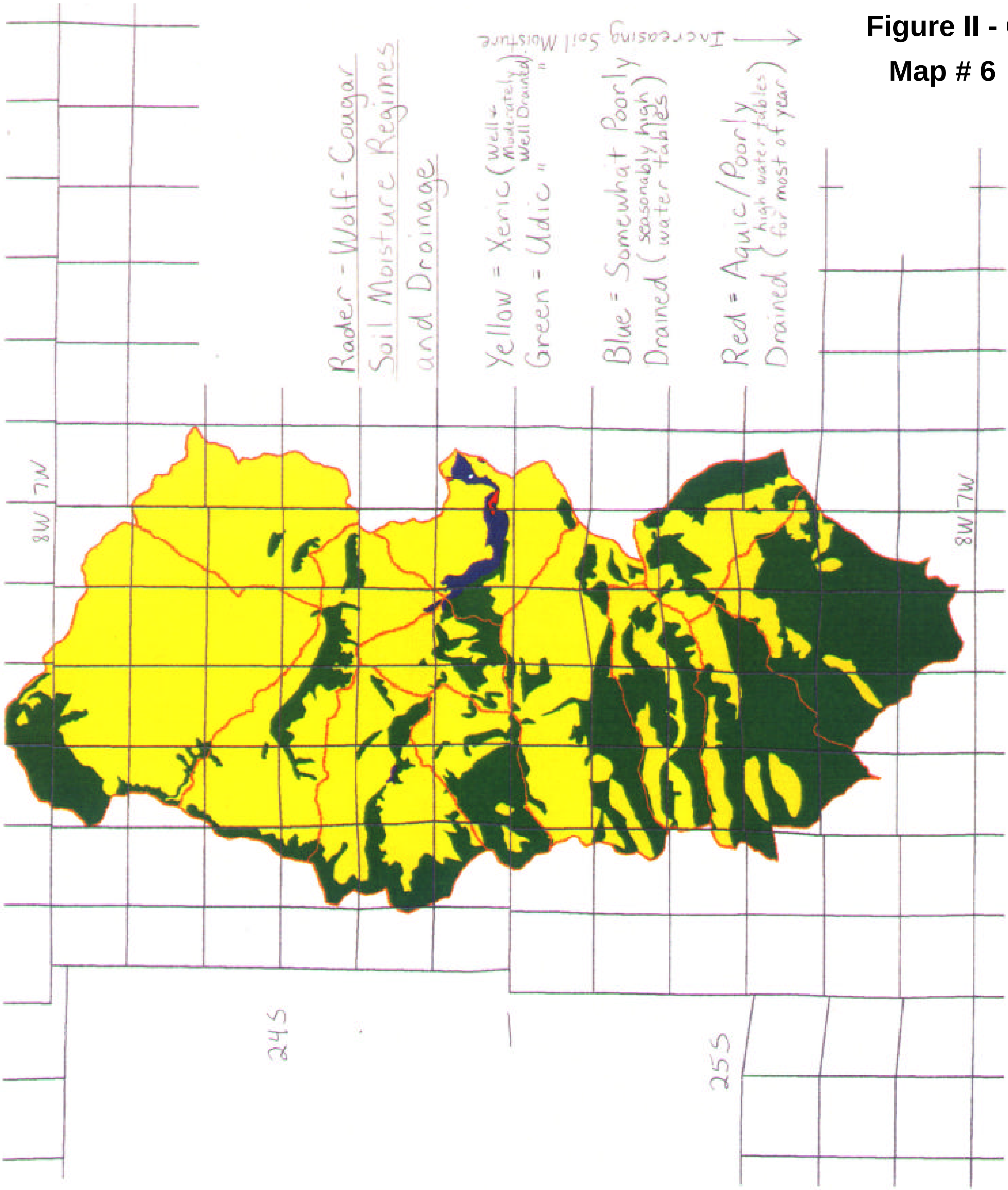


Figure II - 6

Map # 6



Legend for Road Maps # 7 through 10

(Roads in GIS plus those roads added with aerial photo interpretation (1959 to 7/1994)

Purple = asphalt surfacing

Red = rocked surfacing (gravel)

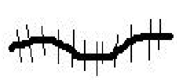
Green = unsurfaced (dirt)

Solid lines in these colors denote high level of confidence of accuracy in mapping these surface types or how it is recorded in GIS.

Dotted lines in these colors denote moderate level of confidence of accuracy in mapping these surface types.

Alternating Green - Red dashes = Lightly rocked roads with segments of no surfacing.

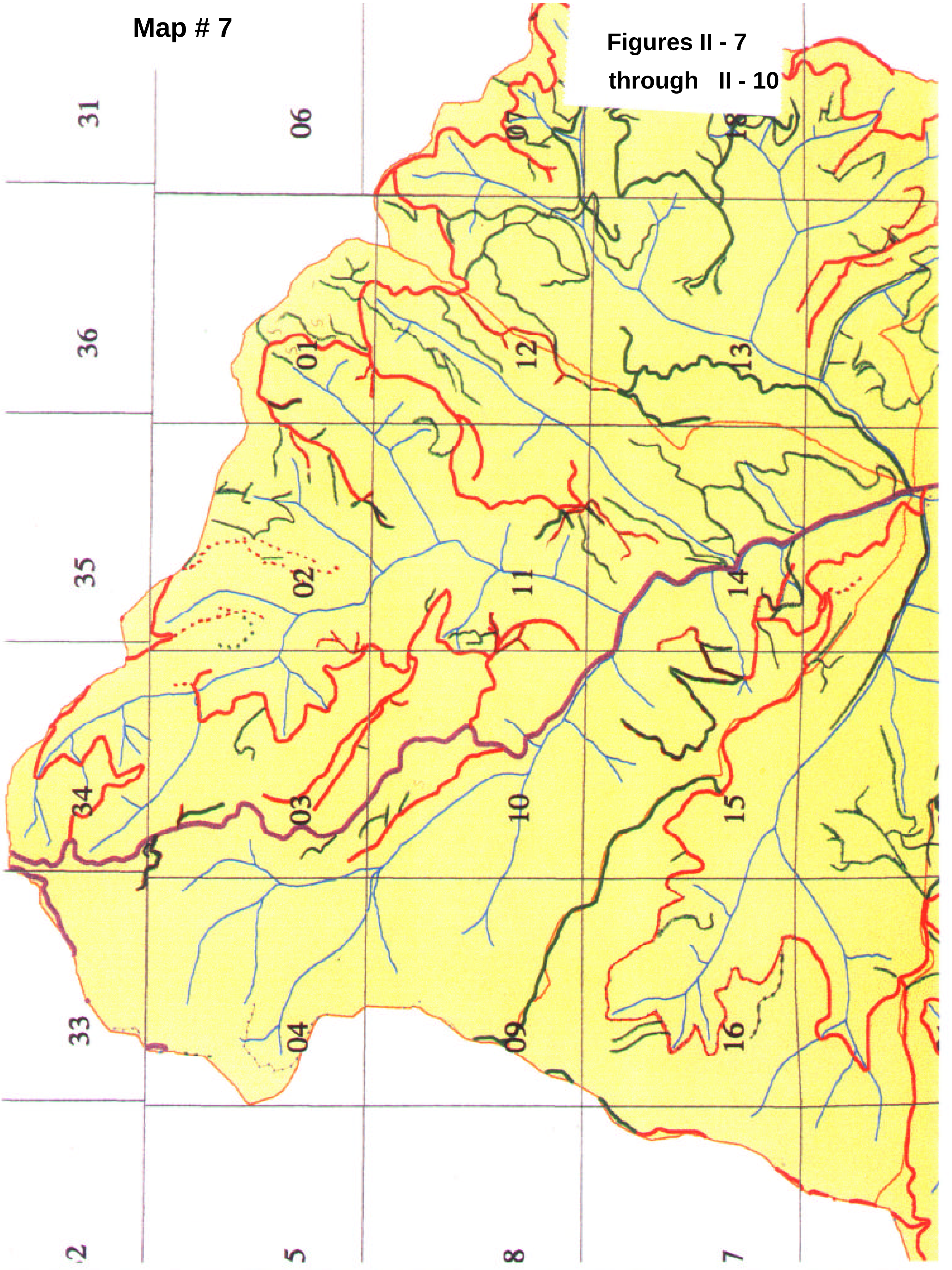
Light grey = In GIS but no data of surface type and/or no field information from watershed analysis study and low confidence in interpreting aerial photos = no surface type indicated



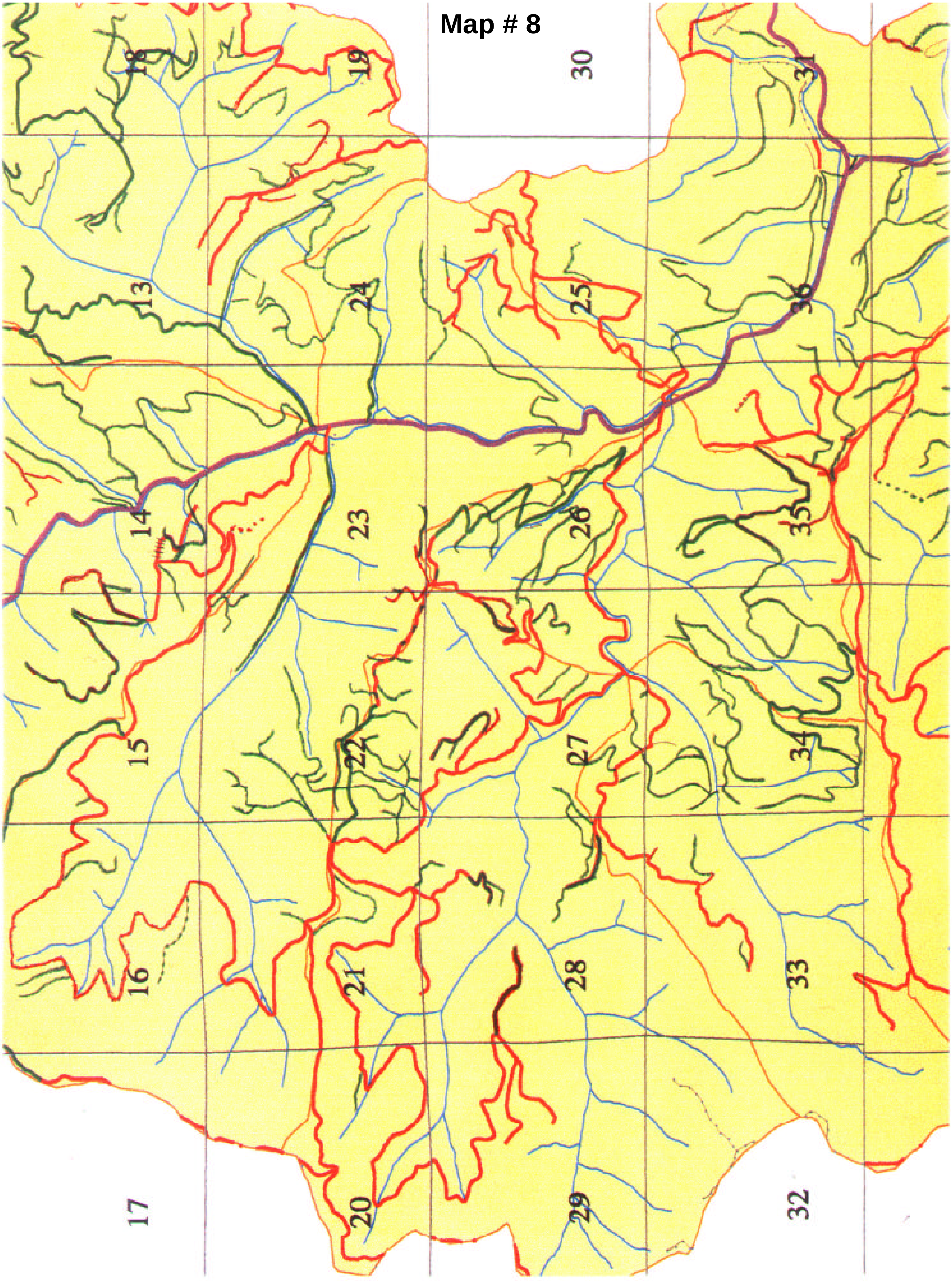
In GIS but never existed

Map # 7

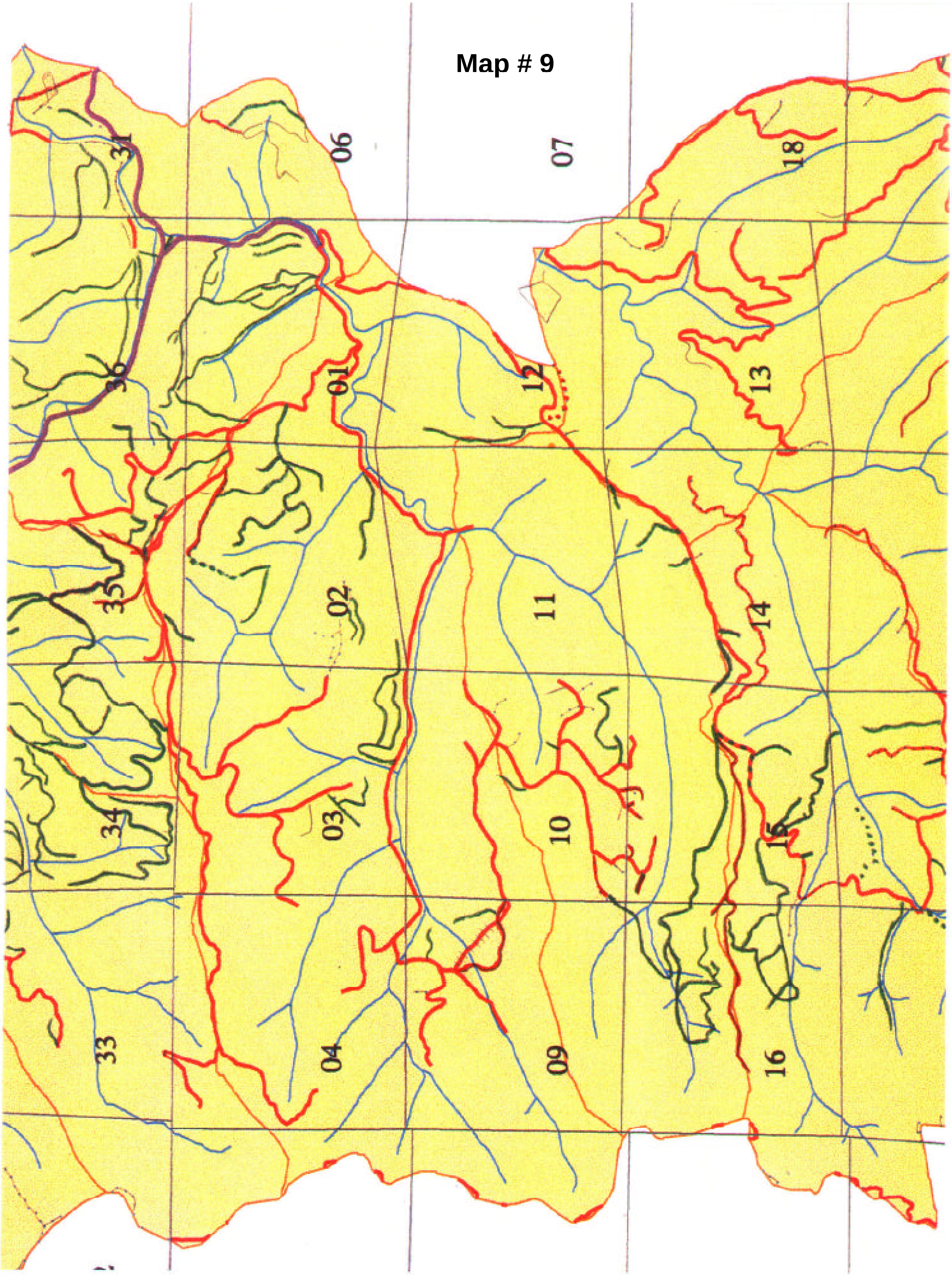
Figures II - 7 through II - 10



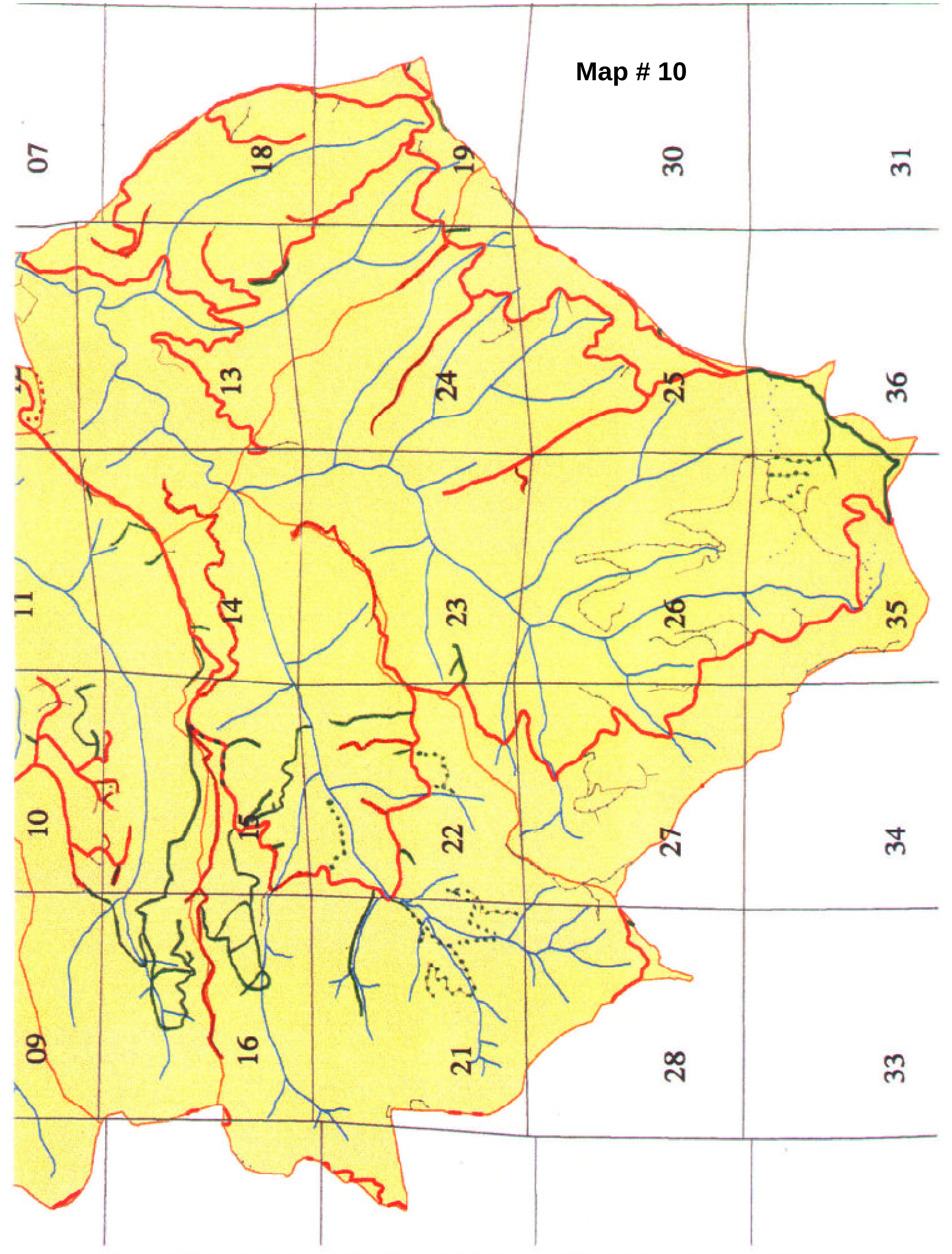
Map # 8



Map # 9



Map # 10



Legend for Field Identified Road Problems

Maps # 11 through 14

Erosion of Roadbed or Ditchline

________ High impact problem

●●●●●●●● Moderate impact problem

Erosion, Ravel, or Sloughing of Cutbanks

_________ High impact problem

●●●●●●●● Moderate impact problem

Road Related Landslides or Washouts

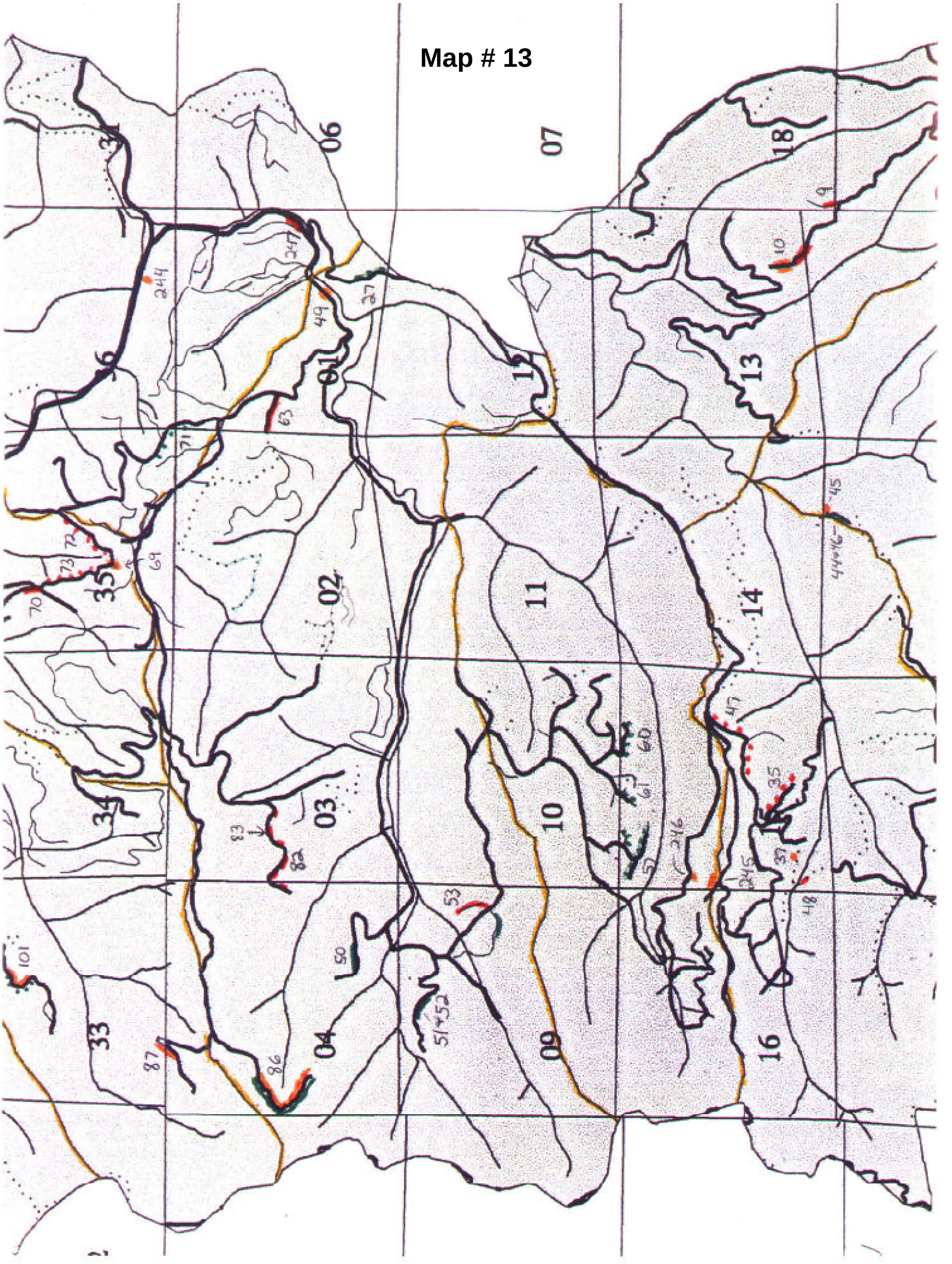
_________ or ●

Map # 11

Figures II-11 through II-14

Map # 12

Map # 13



Map # 14

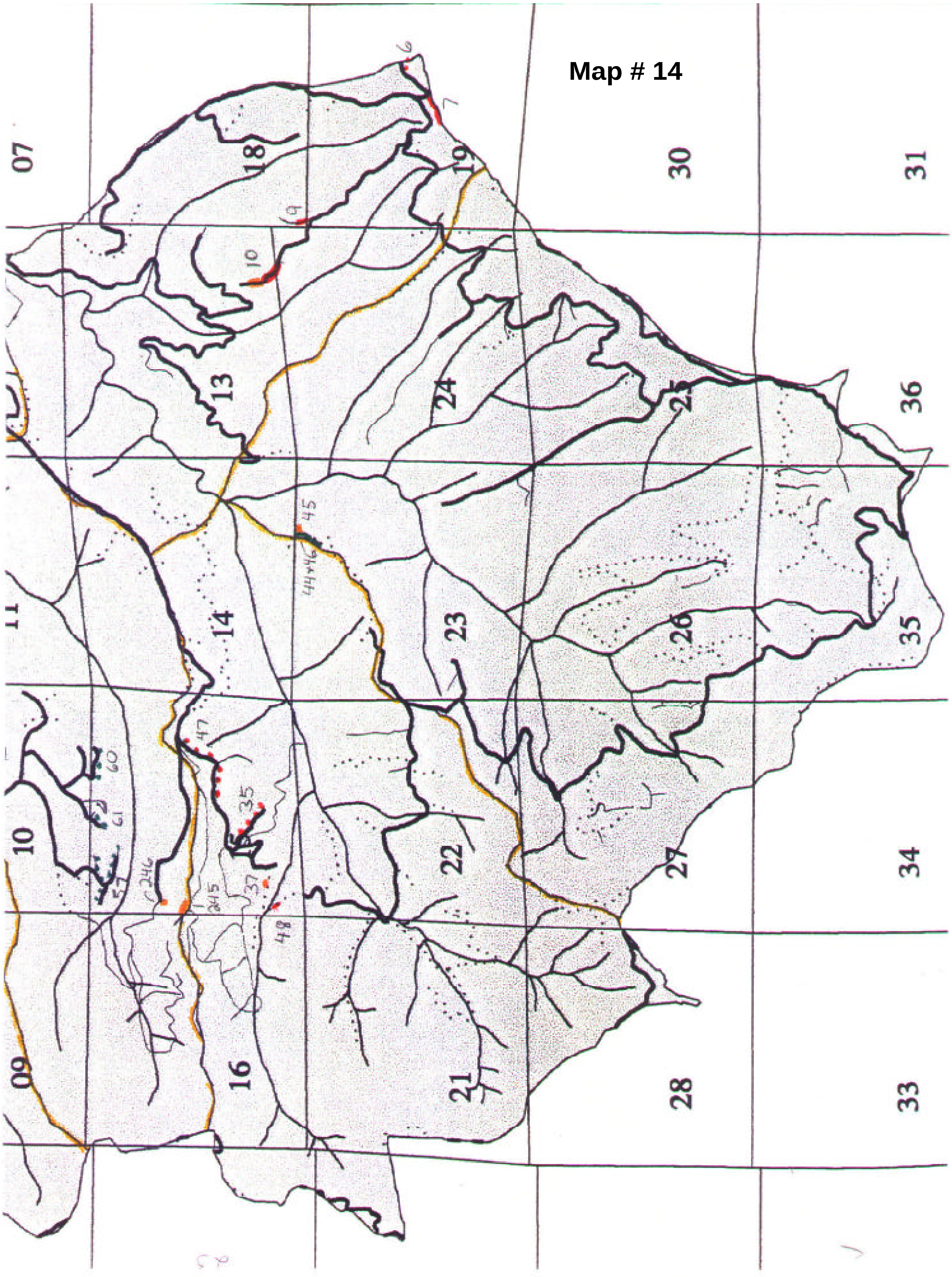


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Figure IV - 1

Forest age classes within the Rader-Wolf-(
Watershed Analysis Unit.

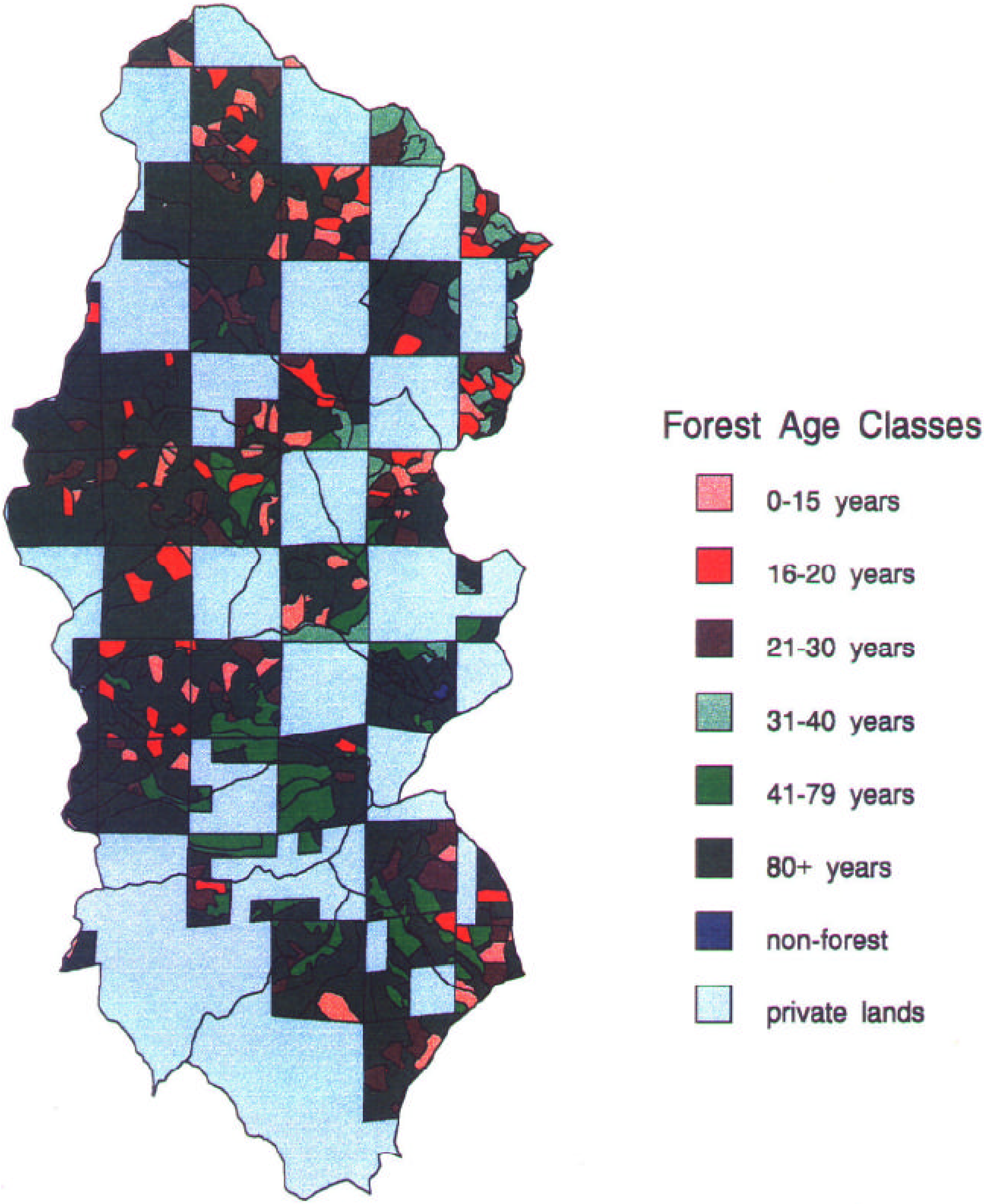
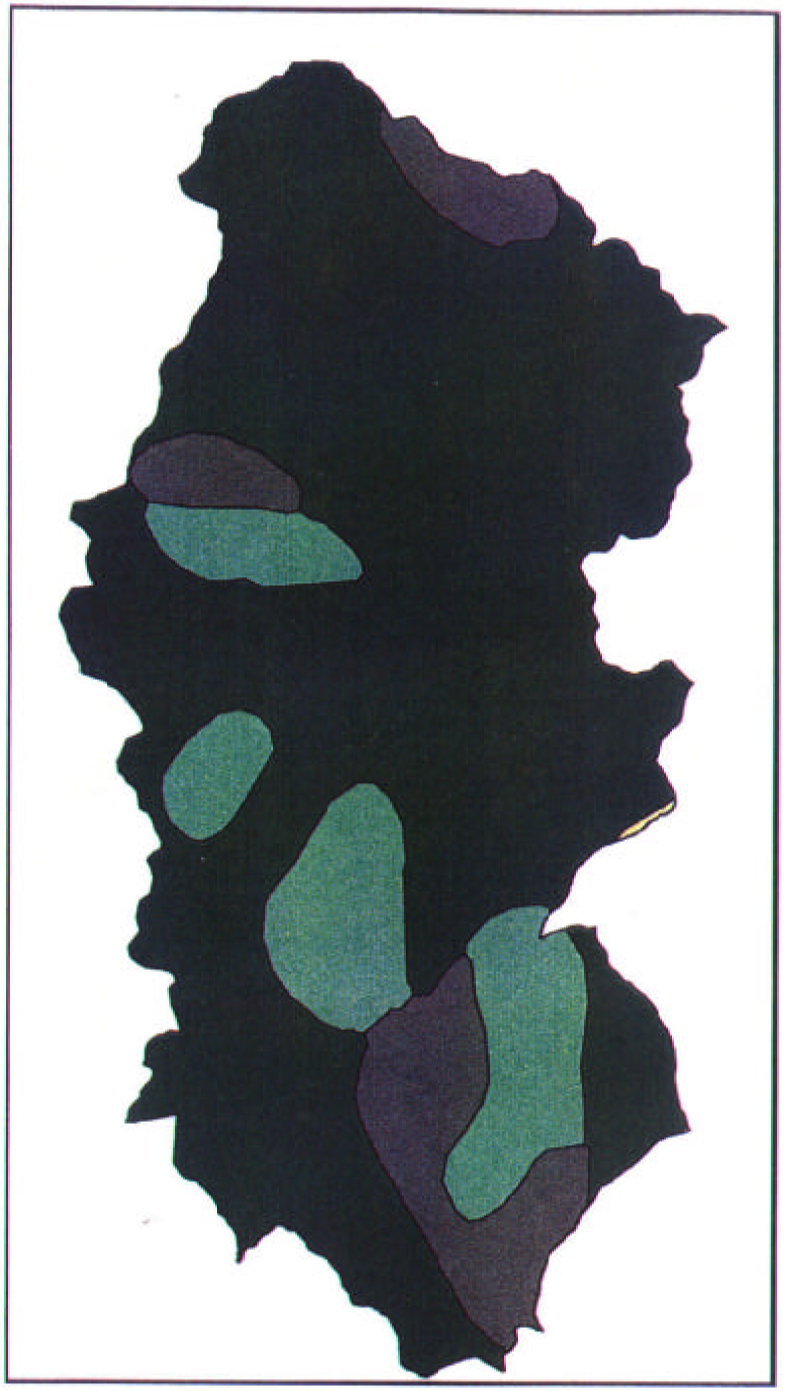


Figure V - 1

This Figure (Fish Distribution)
is a Fold Out Color Map
(Only Available at Roseburg District Office)

Figure IV - 2



!914 Fire map of the Rader-Wolf-Cougar watershed analysis area.

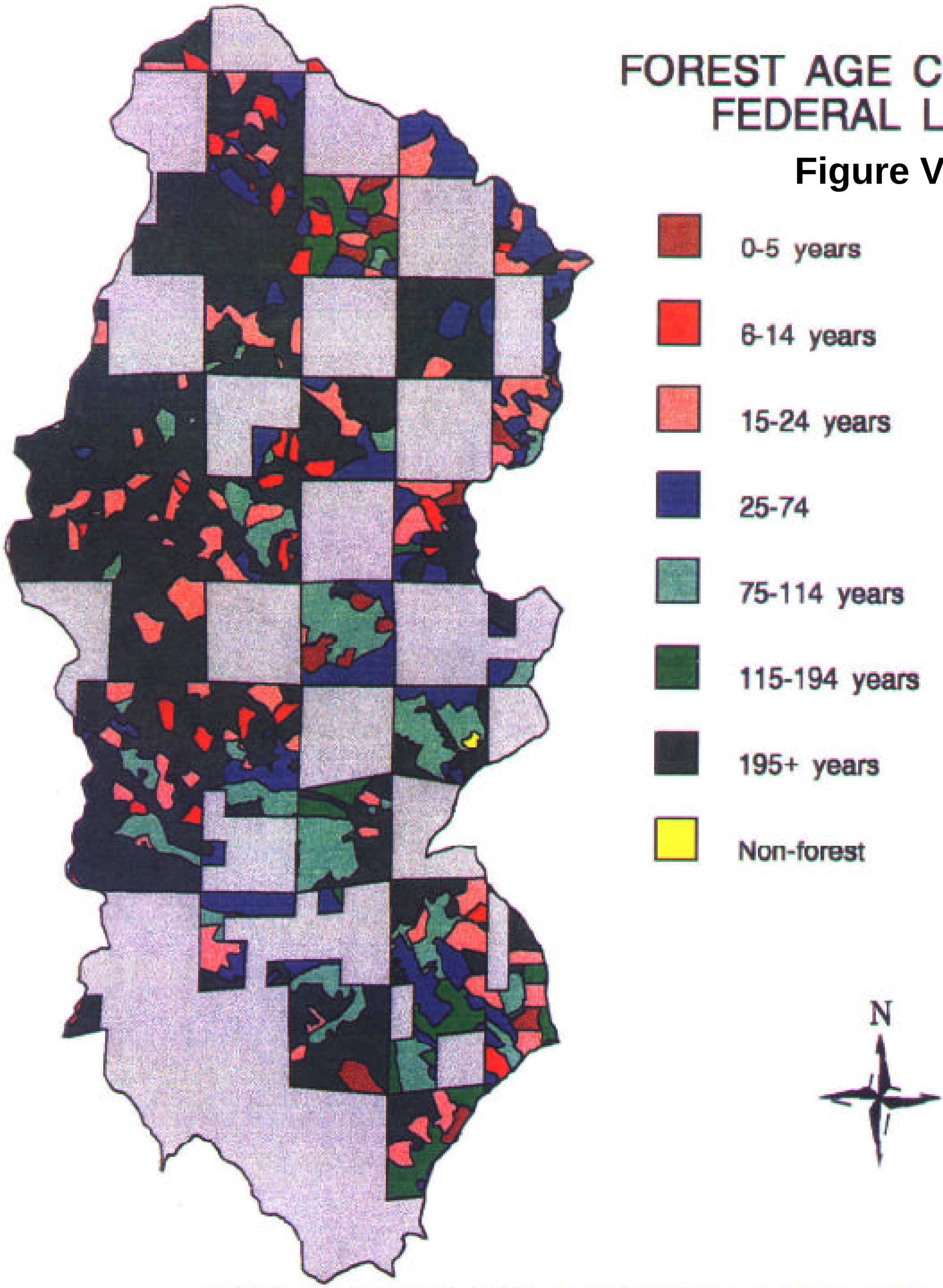
Data	Area (acres)
Merch. Timber	23293.09
Burned, Re-stocking	4397.90
Burned, Not Re-stocking	3352.17
Non-timber	32.81

Legend

Rwc_fire1914
Merch. Timber
Burned, Re-stocking
Burned, Not re-stocking
Non-timber

FOREST AGE CLASS ON FEDERAL LANDS

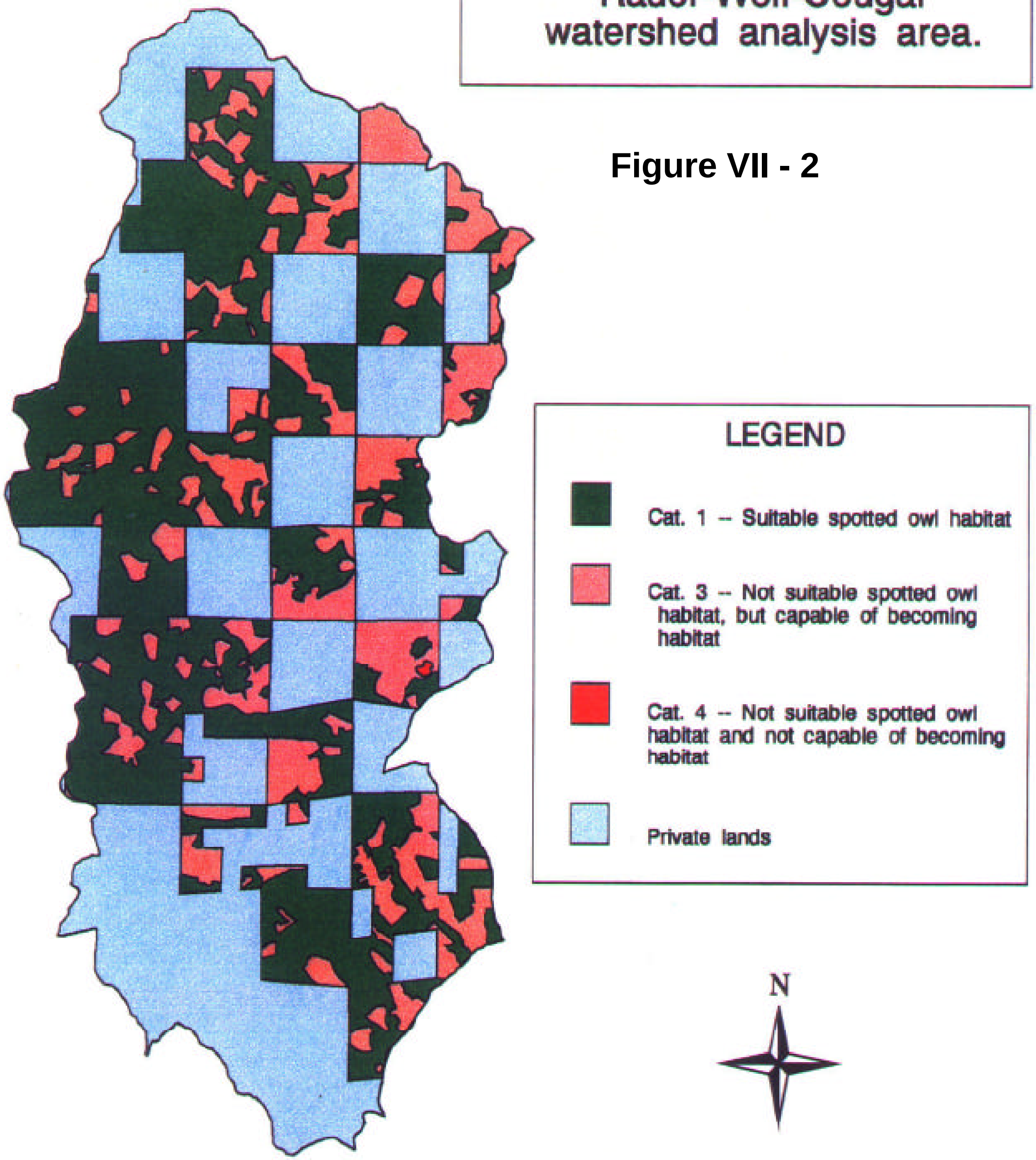
Figure VII - 1



Ageclass	Count	Area (acres)	Avg (acres)
0-5	22	398	18.1
115-194	19	827	43.5
15-24	71	2159	30.4
195+	47	8978	191.0
25-74	70	2254	32.2
6-14	32	622	19.4
75-114	33	1984	60.1
NF	1	13	13.5

Spotted owl habitat within the Rader-Wolf-Cougar watershed analysis area.

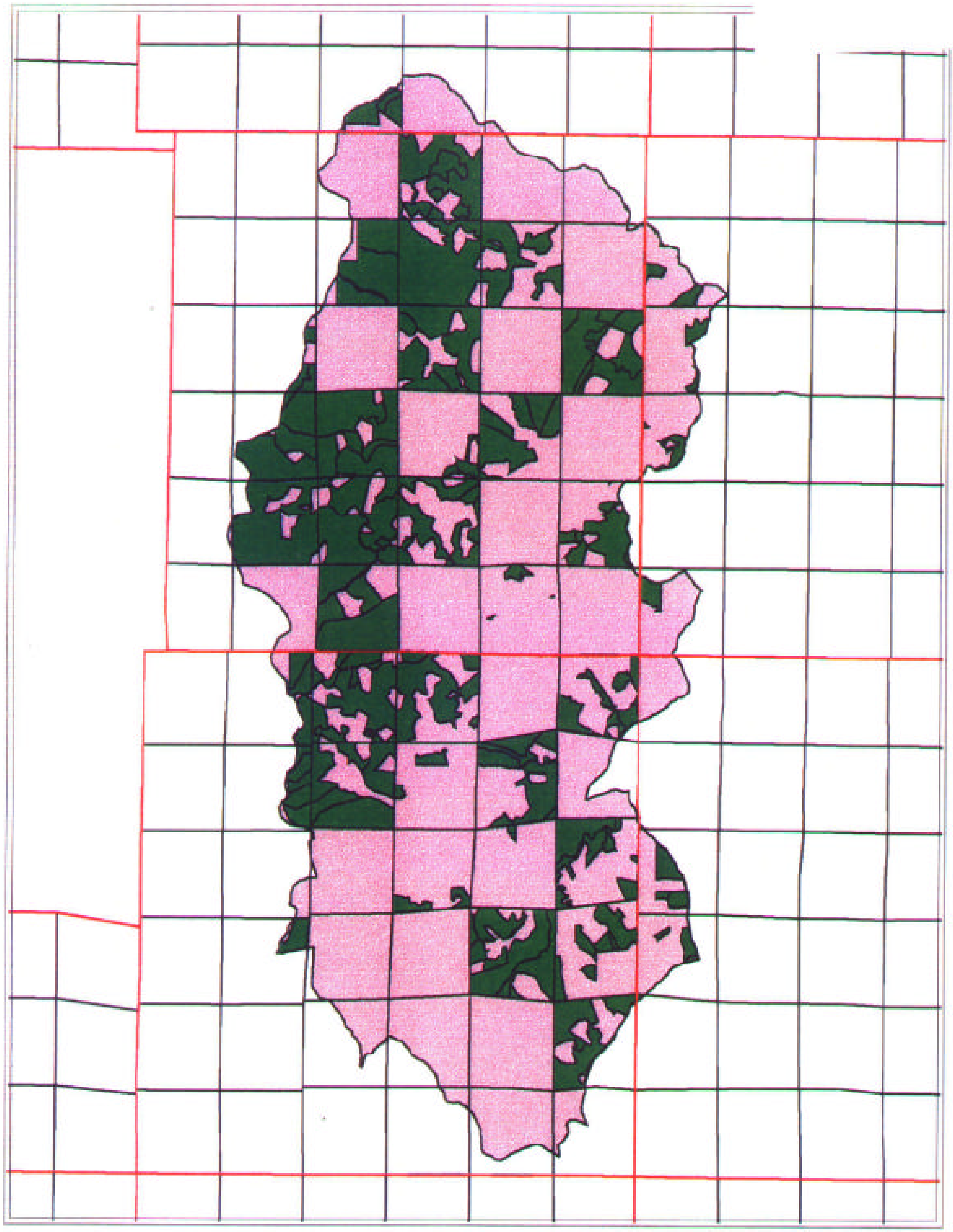
Figure VII - 2



Habitat Type	Count	Area (acres)	Min (acres)	Max (acres)	Avg (acres)
1	44	10989	0.0	5363.4	249.8
3	103	5982	0.0	404.2	58.1
4	1	13	13.5	13.5	13.5

Figure VII - 3

Red tree vole habitat (100+ years



Ageclass	Area (acres)
115-194	827
195+	8978
100-114	124

MAP SHOWING HUMAN USES

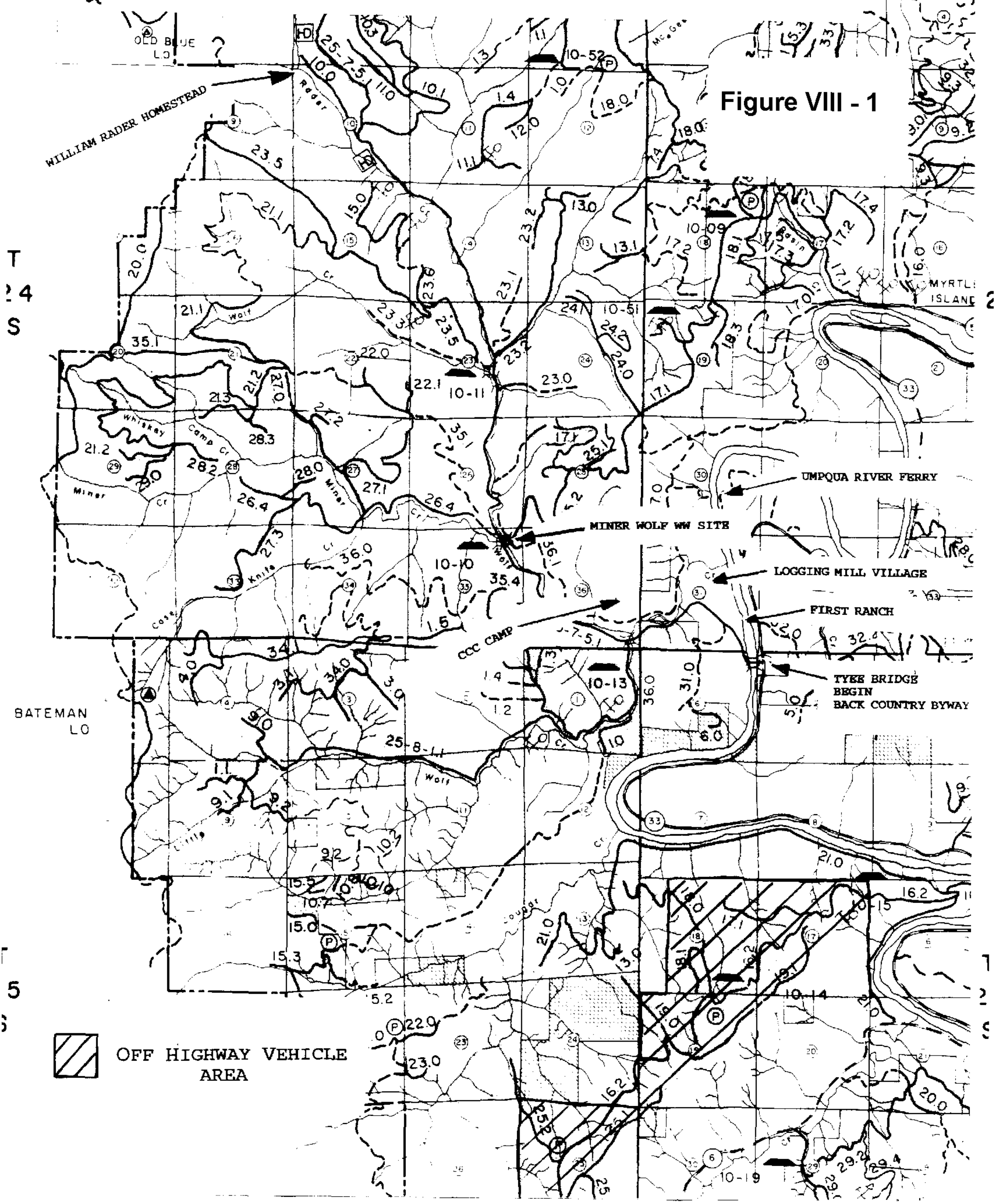


Figure VIII - 1